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Twice best

A flash of gold in green-grey water, jumping silver in the meshes of the wide-mouthed net. Fish are important in the rural economy of Thailand. So, too, are vegetables. Unfortunately, what protects the one can be harmful to the other.

The main vegetable-growing area of Thailand lies in the delta around Bangkok where vegetables sufficient for millions of people are grown over a period of nine months each year. Many pests—particularly the destructive cabbage semi-looper caterpillars and spider mites—attack these growing crops right up to the day of harvest.

To meet the farmers' need for an insecticide which could be safely used up to the day of harvest, Shell's new insecticide Phosdrin was tried—with immediate success. With cabbage loopers, Phosdrin, at a few ounces per acre, achieved a complete kill *within only thirty minutes* and completely eliminated mites on cucumbers. A lower dosage gave control of cut-worms and thrips on onions, and in all cases the crops *remained* 'clean' for several days after spraying. Equally important, this insecticide showed no harmful effect on the fish which teem in the klongs and irrigation ditches between the vegetable gardens. Phosdrin, in the eyes of those who raise both fish and vegetables in Thailand, is indeed twice best.

Phosdrin

Trade Mark.

new systemic Shell insecticide

Phosdrin is the sixth in the series of Shell pesticides. In addition to its uses on vegetable and fruit crops, it has potential applications for the control of insects and mites on forage crops, tobacco, cotton and ornamentals. If **you** *have a pest problem in your area, consult your Shell Company. Between them, aldrin, endrin, dieldrin, Phosdrin, D-D and Nemagon offer control of almost every significant pest.*

Cabbage semi-looper *Phytometra acuta* Walk

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Whitfield (F. G. S.) & Cole (J. H.). **The Bionomics of *Tineola bisselliella*, Humm. under Laboratory Culture and its Behaviour in biological Assay. A. Bionomics. Part I.**—*Lab. Pract.* 7 no. 4 pp. 210–218, 2 graphs, 1 fldg. table, 71 refs. London, 1958. **Part II.**—*T. c.* no. 5 pp. 275–284, 6 figs., 28 refs.

Whitney (G. F. H.). **B. Biological Assay. Part III.**—*T. c.* no. 6 pp. 339–343, 2 graphs, 7 refs. **Part IV.**—*T. c.* no. 7 pp. 408–411, 2 graphs, 4 refs.

Despite the amount of work that has been carried out on the bionomics of *Tineola bisselliella* (Humm.) [*cf. R.A.E.*, A **24** 657; **28** 7; **29** 375; **33** 350], more precise information on the behaviour of the moth under laboratory conditions and on the factors influencing the amount of food eaten by the larvae is required because of the increasing use of the insect in assessing the value of moth-proofing agents [*cf.* **31** 318]. In the studies described in the first two parts of this paper, eggs were laid on a standard light flannel supplemented with an extract of debittered yeast to which cholesterol was added, after which the egg-bearing cloth was incubated in glass jars at 75·2°F. For feeding tests, batches of ten larvae three weeks old were placed in tubes each containing a 5-cm. disk of the supplemented flannel.

The food range, feeding preferences and nutritional requirements of the larvae are reviewed from the literature. It was confirmed that raw wool is an unsuitable diet, although 72 per cent. of larvae reared on felt pads consisting of 75 per cent. coarse wool and 25 per cent. jute gave rise to adults, the life-cycle averaging 73 days. Newly-hatched larvae did not feed on cotton, linen, rayon or silk cloth. Larvae three weeks old lightly cropped small areas of cotton cloth supplemented with yeast and cholesterol, but few achieved even premature pupation. The newly-hatched larvae penetrated linen and silk, but not rayon or cotton, in order to reach supplemented woollen cloth, though a passage appeared to have been forced rather than chewed through them. Fabrics composed of cellulose acetate alone or with 50 per cent. viscose were unsatisfactory foods, although the larvae made some attempt to feed on the mixture. Viscose was also attacked to some extent in tests with a fabric consisting of 50 per cent. wool and 50 per cent. viscose.

Humidity had a marked effect on larval feeding. Larvae kept at 35 per cent. relative humidity ate more cloth than those kept at 85 per cent. over 28 days, but less in 14 days. This was because the larvae at the high humidity developed more rapidly than those at the low one and so ate more over the first 14 days, but during the second half of a 28-day period they ceased feeding and entered the prepupal stage, whereas larvae at the low humidity continued feeding throughout. There was no significant difference in appetite between larvae reared at 35 per cent. and those subjected to a rising relative humidity of 30–80 per cent. in closed containers. Development from egg to adult lasted 63–84, 54–65 and 49–56 days at 70, 75 and 79°F. and 65 per cent. relative humidity, on a diet of flannel supplemented with yeast and dried insects, and adults reared at higher temperatures were smaller than those reared at lower ones [*cf.* **13** 317]. The type of container used was not important, and neither was larval density so long as food was available. Medium and high pH values in woollen materials were preferred to a low one, and the type of cloth was important, since the larvae ate more heavy flannel coating cloth than worsted gaberdine. The amount of food eaten was recorded over a year for three strains of *T. bisselliella* under standard conditions. There was an unexplained variation in the range of

appetite; it showed no periodicity, but the amounts eaten by the three strains tended to rise or fall contemporaneously.

Larvae in the insectary were found to be infected by a polyhedral virus in 1952 [*cf.* **44** 31]. A year later a smaller outbreak occurred, but it is not known whether it was a result of cross-infection from *Tinea pellionella* (L.) or reactivation of a latent infection. Larvae also became infected by an unidentified sporozoan parasite. Both infections caused a reduction in appetite sufficient to invalidate test data.

The use of *T. bisselliella* for the evaluation of moth-proofing agents is discussed in the last two parts. The response of the larvae to a chemical is graded, depending on the concentration used [*cf.* **40** 28]. Cloth weight loss gave the most satisfactory measure of effectiveness, although visible damage is the effect of most interest to the industry; in practice, visual assessments varied widely. In a test with Mystox B (containing 20 per cent. pentachlorophenol) on light flannel, visual damage was impossible to assess on unproofed cloth and on that treated with the two lowest concentrations (0·12 and 0·13 per cent. pentachlorophenol), but at 0·23–0·7 per cent. the visual scores were close to each other, though there was a higher yield of frass at the highest concentration. The logarithmic graph of frass weight plotted against dose approximated to a straight line, as also did that of cloth weight loss against dose, and, as in the visual scores, it was the highest dose that was exceptional, indicating that frass might still be produced after feeding had ceased. Experiments on proofed and unproofed cloth showed that supplementing the diet multiplied the weight loss by a factor that was constant for any single series, but supplemented fabrics were not used when tests were run with more than ten larvae per disk. Variance in the dosage-response relation is discussed, and the procedures to be used in tests of different types are reviewed.

Singh (K. R. P.) & Pant (N. C.). **Nutritional Studies on *Trogoderma granarium* Everts. Effects of various natural Foods on the Development.**—*J. zool. Soc. India* **7** no. 2 pp. 155–162, 8 refs. Calcutta, 1955.

The nutritional requirements of *Trogoderma granarium* Everts were studied in India in experiments in which newly hatched larvae from a culture maintained on wholemeal wheat flour with the addition of 5 per cent. dried brewers' yeast at 36°C. [96·8°F.] and 50–65 per cent. relative humidity were reared at the same temperature and a relative humidity of 45–50 per cent. on various cereals, millets and pulses as whole grains or as flours. The suitability of each medium was assessed from the period elapsing between hatching and adult emergence and the percentage of larvae that completed their development on each. Wheat flour provided the most satisfactory medium among the cereals and was surpassed only by seeds of *Phaseolus aureus*. Grains of wheat and rice, flours of barley, maize, sorghum and *P. aureus*, and the grain and flour of *Pennisetum typhoides* were in general superior to the remaining pulses tested [*cf. R.A.E.*, A **35** 69], though they were equalled by flour of chick peas (*Cicer arietinum*). Larvae were unable to develop on unhusked barley or rice, few did so on grains of maize and virtually none on grain of a very hard variety of wheat, on the flour of which development was normal. None developed in seeds of *C. arietinum*, pigeon pea (*Cajanus cajan*) or lentil (*Lens esculenta*) and development was poor in flour of the last two and on seeds of mungo bean (*Phaseolus mungo*). The addition of yeast to the pulses enabled more larvae to survive except in the case of *C. cajan*, but their development was very slow.

Patel (H. K.). **The Furniture Carpet-beetle** (*Anthrenus vorax* **Waterhouse**).—*Mem. ent. Soc. India* no. 6, [1+] 47 pp., 14 figs., 57 refs. New Delhi, 1958.

Anthrenus flavipes Lec. (*vorax* Waterh.) is a pest of household goods and stored products in many tropical and subtropical countries. Its distribution is reviewed and shown on a map, together with that of the three other important species of the genus, and a further map is given showing the zones of the Old World in which the development of less than one, 1–2, 2–3 and more than three generations a year is possible. It is unlikely to be important in temperate regions. All stages of the Dermestid, including the reproductive systems of both sexes, are described. Species of *Anthrenus* have hitherto been identified by their colour patterns, and this has resulted in some confusion. It is suggested that the size and shape of the scales may provide a more ready means of separation.

In laboratory studies on the bionomics of *A. flavipes* [*cf. R.A.E.*, A **22** 189; **25** 291; **30** 556], the numbers of eggs laid per female ranged up to 36 [*cf.* **25** 291] and varied with the diet; the averages were 23 for females kept without food or water, 22 for those given water only, 28 for those fed with syrup and honey, and 31 for those given milk. Temperature had more effect than relative humidity on the duration of the egg stage, which ranged from an average of 27·7 days at 70°F. and 37 per cent. relative humidity to 7·4 days at 81·6°F. and 26 per cent. relative humidity, and was prolonged by daily ultraviolet irradiation of the eggs. The duration of the larval stage also varied inversely with temperature, averaging 110·3 days at 81·6°F. and 115·8 days at 70–85°F. (fluctuating room temperature) when yeast was included in the diet. The period was reduced by low relative humidities at 81·6°F. and by a high humidity at the fluctuating room temperature. Without yeast, it was increased to about 155 days. The presence of yeast in the diet appeared to favour development; larvae fed on wool alone did not increase in size, even after 246 days and passing through nine moults, whereas the addition of yeast to wool enabled the larvae to pupate in a maximum of 56 days at 81·6°F. and 26 per cent. relative humidity. Woollen cloth of all colours was eaten, but the amounts consumed decreased for cloth dyed green, blue, red, yellow, white or black, in that order, and all the larvae died when confined on black cloth. The number of moults and the duration of each instar were very variable. A total of 5–14 moults seemed normal, and the duration of each instar was 7–27 days for males and 12–26 days for females at 81·6°F., and 6–37 and 7–38 days, respectively, at the fluctuating room temperature. Newly-hatched larvae survived for 6–8·7 days without food, and second-instar individuals for about twice as long. Relative humidity played an important part, unfed larvae dying more rapidly at higher humidities than at lower ones, irrespective of temperature. The duration of the pupal stage (including the period before the newly emerged adult left the pupal case, which lasted for about one-third of it) at 81·6°F. averaged 23·8, 23·1 and 16·4 days at 37, 73·4 and 80 per cent. relative humidity, respectively. At 70–75°F., the stage lasted 38·4 and 17·6 days at relative humidities of 37 and 73·4 per cent. The pupal period was extended progressively by ultraviolet irradiation for 1–5 minutes per day, but exposure for 10 minutes a day had no further effect. The egg-laying capacity of females from irradiated pupae was greatly reduced, and the eggs laid tended to be abnormal. The preoviposition period of the females lasted 3–30 days and was usually 3–8 days. Unmated males and females survived for averages of 33·5 and 45·3 days, respectively, at 81·6°F. and 29 and 56·4 days at the fluctuating room temperature, and the duration of life from hatching to death of the adult averaged 176·5 days for males and 200 days for

females at 81·6°F. and about ten days less at the fluctuating temperature. Out of 1,000 insects of different generations, 56·8 per cent. were males.

Markkula (M.) & Myllymäki (S.). **On the Size and Location of the Eggs of *Apion apricans* Herbst, *A. assimile* Kirby, *A. flavipes* Payk., *A. seniculus* Kirby, and *A. virens* Herbst (Col., Curculionidae).**—*Ann. ent. fenn.* **24** no. 1 pp. 1–11, 5 figs., 5 refs. Helsinki, 1958.

The investigations described were carried out in conjunction with those noticed earlier [*R.A.E.*, A **46** 361] to ascertain whether there were any differences in the sizes and distribution on the plant of the eggs of the species of *Apion* that infest clover in Finland. The eggs are described, and their dimensions given. On red clover [*Trifolium pratense*], *A. apricans* Hbst. laid 96 per cent. of its eggs in the florets, usually singly, *A. assimile* Kby. laid 65 per cent. of them in the florets, 26 per cent. in the stipules and 7 per cent. in the peduncles, usually in groups of 2–6, and *A. virens* Hbst. laid 52 per cent. in the stems, 43 per cent. in the petioles and 5 per cent. in the peduncles, almost all singly. On alsike clover [*T. hybridum*], *A. dichroum* Bedel (*flavipes* (Payk.)) laid 99 per cent. of its eggs in the florets, mostly singly, and *A. seniculum* Kby. laid 97 per cent. in the stems, all singly.

Lamb (K. P.). **Alate Aphids trapped in Auckland, New Zealand, using Moericke Colour Traps.**—*N.Z. J. Sci.* **1** no. 4 pp. 579–589, 4 figs., 1 fldg. table, 14 refs. Wellington, N.Z., 1958.

Thompson (H. R.). **Note on the Efficiency of Aphid Trapping.**—*T. c.* pp. 614–616, 5 refs.

The dispersion of alate aphids was investigated in New Zealand in connection with work on the cabbage aphid, *Brevicoryne brassicae* (L.), and the results are given in the first of these papers, of which the following is almost entirely the author's summary. Eight Moericke traps [*cf. R.A.E.*, A **45** 315] painted with two types of yellow paint were exposed for 12 months at crop height in an area near Auckland planted with a variety of cruciferous vegetables. They were cleared every two or three days and the aphids counted and identified. During the year, 4,272 aphids belonging to 24 genera and 39 species were collected. The most abundant were *Rhopalosiphum* (*Lipaphis*) *pseudobrassicae* (Davis) (*erysimi*, auct.), *Myzus persicae* (Sulz.), *B. brassicae*, *Hyadaphis foeniculi* (Pass.), and *M. ornatus* Laing, which together constituted 83 per cent. of the total. Traps coloured with zinc chromate priming paint were generally more efficient than those painted with a bright yellow chlorinated rubber paint, but the aphids differed in their relative reactions to the two paints. *M. persicae*, *M. ornatus*, *B. brassicae* and *Macrosiphum rosae* (L.) showed a strong and *R. pseudobrassicae* a weaker preference for zinc chromate, while *H. foeniculi* was found in equal numbers on both paints. Discrimination between the two paints was attributed to differential response of the various species to the yellow and blue-violet regions of the spectrum. Total weekly catches were strongly correlated with mean air temperature, but not with amount or frequency of rainfall, hours of bright sunshine, wind, or length of day. The other aphids caught included *Myzus ascalonicus* Doncaster and *Rhopalosiphoninus latysiphon* (Davidson), neither of which had previously been recorded in New Zealand.

The following is substantially the author's summary of the second paper. From the distribution of numbers of the alate aphids taken in the traps, it

is deduced that the sample covered nearly 99·9 per cent. of the population, in terms of the species represented in it, and that another sample of the same size, taken in conjunction with the first, would approximately halve the proportion of the population not represented and would furnish only 3–4 species not already trapped.

VAN ASPEREN (K.). **The Mode of Action of an Organophosphorus Insecticide (DDVP). Some Experiments and a theoretical Discussion.**—*Ent. exp. appl.* **1** no. 2 pp. 130–137, 1 graph, 10 refs. Amsterdam, 1958. (With a Summary in German.)

Investigations in Holland showed that DDVP (dimethyl 2,2-dichlorovinyl phosphate) is highly toxic to *Musca domestica* L. but much less so to mammals. Vapour concentrations that killed the flies in two minutes were harmless to mice, even after an exposure of six hours, and the LD50's for the flies were 0·18 and 1·5 μg. per g. when DDVP was applied to them by injection and topically, respectively, as compared with 10 and 15 μg. per g. when it was applied to mice by intravenous and subcutaneous injection.

Since it is claimed that organophosphorus compounds act by inhibition of cholinesterase activity in the nervous system, inhibition by DDVP was studied *in vitro*. The results showed a striking correlation between inhibition of mouse-brain cholinesterase and aliesterase and house-fly cholinesterase and aliesterase and toxicity to mice and flies, respectively. The conclusion seemed justified that there was a causal relation between cholinesterase inhibition and toxicity, but the correlation might be due to some other factor, such as more rapid metabolism of DDVP by mammalian tissues and homogenates than by those of flies.

Different susceptibilities of mammalian and house-fly homogenates to inhibition by DDVP do not necessarily indicate that the enzymes differ chemically. The difference might be due, for example, to the presence of other compounds, such as proteins, in the suspensions; these might influence the inhibition values by binding and thus inactivating the DDVP molecules. Possible differences in the cholinesterases of house-flies and mice were therefore investigated. The substrate specificity of house-fly cholinesterase was tested *in vitro* with 12 different substrates, and it was found from the results, which are to be published in full elsewhere, that fly-head cholinesterase shows in general the characteristic properties of "true cholinesterase", as found in mammalian brain tissue, excess substrate inhibiting the action as far as choline esters are concerned, and activity being high against triacetin and extremely low against benzoylcholine. The only deviation was the more rapid hydrolysis of butyrylcholine, which, however, showed the well-known inhibition by excess substrate. Specific differences between the enzymes may therefore exist, but there is no reason to consider house-fly cholinesterase as a special type, and large chemical differences are not to be expected.

Further tests were carried out to ascertain whether the differences in inhibition by DDVP are due to structural differences in the enzymes or to other factors present in the homogenates. Homogenates of mouse brain and fly head were prepared, and enzyme inhibition by DDVP was tested with acetylcholine as substrate. It was found that a concentration of 10^{-8} M. DDVP caused 100 per cent. inhibition of fly-head cholinesterase and only about 10 per cent. inhibition of mouse-brain cholinesterase. Mixtures of the two in various proportions were then tested, and the inhibition values obtained were compared with those calculated on two hypotheses, namely, that there is no essential difference between the cholinesterases, the difference in inhibition being caused by the binding of DDVP molecules by other

(most probably protein) molecules, and that the difference in susceptibility is due to differences between the enzymes themselves. There was almost complete agreement between the results obtained and those calculated according to the second hypothesis, so that differences in inhibition are probably due, at least in part, to enzyme differences. Some evidence as to the nature of these was obtained, for it was observed in the case of mouse-brain homogenates that there was a slow decrease of inhibition during the first hours after addition of the substrate, whereas there was no such decrease for fly-head homogenates; 50 per cent. reactivation of mouse-brain cholinesterase activity was observed in the course of two hours, so that inhibition of mouse-brain cholinesterase may be slowly reversible, whereas that of fly-head cholinesterase is completely irreversible. The difference in susceptibility to DDVP-inhibition may be partly due to this difference in reversibility.

Collyer (E.). **Some Insectary Experiments with predacious Mites to determine their Effect on the Development of** *Metatetranychus ulmi* **(Koch) Populations.**—*Ent. exp. appl.* **1** no. 2 pp. 138–146, 5 graphs, 6 refs. Amsterdam, 1958. (With a Summary in German.)

The following is based largely on the author's summary. As orchard spraying experiments give results that are difficult to interpret in terms of individual predator species, experiments were carried out in an insectary in southern England to estimate the effect of predacious mites on populations of *Panonychus* (*Metatetranychus*) *ulmi* (Koch), in the absence of other prey. Known numbers of each were placed on seedling plants, and the development of the resulting populations observed. In one experiment, in which initial numbers of 5, 25 or 50 females of *P. ulmi* were placed on a plant, together with five females of *Typhlodromus tiliae* Oudm., the population of *P. ulmi* remained throughout the following three months at a density of less than one mite per leaf, which was less than a total of 50 mites per plant. Where the same initial numbers of *P. ulmi* were used in the absence of *T. tiliae*, rapid increase resulted in populations of over 3,000 mites per plant in up to 11 weeks. Both the size of the plant and the initial numerical ratio of the two mites affected the development of populations of *T. tiliae*.

Of the other predacious species, *T. finlandicus* (Oudm.) was similar to *T. tiliae* in its effect on *P. ulmi*, but *T. umbraticus* Chant, *T. tiliarum* Oudm. and *Phytoseius macropilis* (Banks) had little effect, although the first of these developed well and increased steadily in numbers.

Kuenen (D. J.). **Influence of sublethal Doses of DDT upon the Multiplication Rate of** *Sitophilus granarius* **(Coleopt. Curculionidae).**—*Ent. exp. appl.* **1** no. 2 pp. 147–152, 3 graphs, 3 refs. Amsterdam, 1958. (With a Summary in German.)

The following is virtually the author's summary. *Calandra* (*Sitophilus*) *granaria* (L.) was exposed to very low doses of DDT mixed with the wheat in which it was reared (0, 0·1, 0·125, 0·25 mg. DDT per 100 g. wheat). The weevils exposed to 0·1 and 0·125 mg. produced about 20 per cent. more offspring than the unexposed weevils. At 0·25 mg. DDT, the reproduction was even higher per living female in the first five weeks, but mortality was high and the total number of offspring was much lower than in the other cultures. The results are compared with previous results, obtained by exposing *Panonychus* (*Metatetranychus*) *ulmi* (Koch) to DDT [*cf. R.A.E.*, A **43** 341], and it is suggested that the less susceptible an arthropod species

is to DDT the greater the possibility that stimulation of reproduction will be found.

Heseltine (H. K.) & Thompson (R. H.). **The Use of Aluminium Phosphide Tablets for the Fumigation of Grain.**—*Milling* **129** pp. 676–677, 730–731. 732, 752, 774–775, 778, 783, 4 figs., 3 refs. Liverpool, 1957.

A method of fumigation by means of phosphine gas evolved slowly from tablets of aluminium phosphide and ammonium carbonate has been developed [*cf. R.A.E.*, A **45** 294], and its suitability for the treatment of grain stored under different conditions in Britain was investigated. Most of the tests were carried out with naturally infested grain, and, in addition, cages or bags containing test insects, generally adults and immature stages of *Calandra granaria* (L.), were inserted at different levels. In work with deep silo bins, two bins, each with a capacity of 110 tons and without an aspirating system, were filled with infested wheat of which the temperature was 51–59°F. and the moisture content 14·1–14·7 per cent. Tablets were thrown in by hand from the inspection openings as filling proceeded and were distributed as evenly as possible over the surface of the grain at rates of 10 and 15 per ton. When filled, the bins were sealed with sisalkraft. No measurable quantity of phosphine was detected in the working space during the process. The bins were opened and the grain turned after five days which is the usual period for fumigation by this technique. During turning, concentrations of phosphine were highest at the points of discharge from the bin or elevator to the conveyor band and in the back draught near the inspection opening of the bin being filled; at head height, they did not exceed 0·04 mg. per litre. The grain was again turned ten days later; the phosphine concentration in the space above the grain in one bin exceeded 0·1 mg. per litre before the process, but no measurable quantities were detected during it. Of the test insects (*C. granaria*), which were placed above the grain and in it at depths of up to 50 ft., all the adults and virtually all the immature stages were killed. Concentrations of phosphine were considerably lower at the centre of the bin, where the grain entered it, than at the sides, probably owing to carriage of the tablets by the grain stream. Concentration-time products varied from 400 to 3,000 mg. hours per litre; one of about 10 mg. hours per litre controls adults of *C. granaria* and *C. oryzae* (L.), but the immature stages are more resistant, and one of 300 mg.-hours per litre is reported to be necessary against young pupae. In two other tests, in which the tablets were applied in the same manner in one bin at a rate of about four per ton and to the grain on the conveyor belt entering another at about five per ton, there was some survival among the late immature stages of *C. granaria* and larvae of *Trogoderma granarium* Everts used as test insects, but adults of *C. granaria* and adults and late immature stages of *Oryzaephilus surinamensis* (L.) and *Cryptolestes pusillus* (Schönh.) (*minutus* (Ol.)) were all killed. The concentration of phosphine when the wheat was turned five days after treatment was in general about 0·01 mg. per litre, with a maximum of 0·03. Neither the wheat, whether whole or ground, nor wholemeal bread prepared from it, was tainted by the treatment, and the size and texture of the bread was not affected. The concentration-time products within the grain varied from 100 to 300 mg. hours per litre, and neither method of application gave uniform distribution. Almost complete control of the immature stages of *Calandra granaria* was also obtained in a larger bin, 116 ft. deep and with a capacity of 230 tons, in which 6½ tablets per ton were applied to the grain entering on the conveyor belt and the fumigation period was extended to seven days; no measurable quantity of phosphine was noted in the working spaces at any time, and milling and baking tests showed no tainting. The concentration

again varied considerably, but the general level was high. This method of fumigation is more costly than treatment with methyl bromide or carbon tetrachloride, and is considered most suited for silos in overseas territories, where the bins are not fitted with a circulatory system and the high cost of the material is offset by the low freight charges.

An experiment with grain stored on the floor was carried out in a room 105 ft. long and 65 ft. wide, with a capacity of about 600 tons, in a corner of which 100 tons of wheat was heaped, mostly to a height of 4 ft. The wheat, of which the moisture content was 10·6–10·7 per cent. and the temperature 61–70°F., was infested lightly by adults and moderately by larvae of *Rhizopertha dominica* (F.), *Latheticus oryzae* Waterh. and *Cryptolestes* sp. Tablets were applied by means of an applicator probe at a rate of 20 per ton, and the room was left closed for four days, during which it was ventilated continuously through louvres. Two days after the room was opened, the insects were dead and the temperature of the wheat had fallen to 52–65°F., but three living adults of *R. dominica* and evidence of light larval infestation were found in grain that had spilled out from between the bulkhead boards; the grain stack was still free from infestation a month later. Adults of *Calandra granaria* placed as test insects in the grain were dead or moribund except where the cages were partly exposed, but some immature stages survived at all positions. Concentration-time products did not exceed 250 mg. hours per litre except at one point, and concentrations of phosphine above the grain were negligible. Analysis of material from spent tablets near the surface indicated a residue of 0·97 per cent. undecomposed aluminium phosphide. Better control might have been obtained had the grain been covered.

On farms, grain is stored in small bins with a capacity of 20–30 tons; these are less gas-tight than silo bins and are often open-topped and are difficult to seal effectively. Eight such bins situated in a Dutch barn, each with a capacity of about 30 tons and constructed of concrete blocks keyed into one another, were selected for test. They contained wheat, oats or barley heavily infested by *O. surinamensis*, the grain temperatures were 42–62·5°F., and treatment was by means of an applicator probe fed by hand at rates of 15 and, in the case of one of two test bins, ten tablets per ton. The bins were treated in groups of four, to enable the application on each occasion to be completed in an hour (the maximum period desirable for working with this material), and were covered with gas-proof sheeting for five days. Examinations five days and two months after treatment showed that control of the infestation was virtually complete, though on the second occasion a few adults were seen on the bin walls above the oats and in an adjacent empty bin. Of the test insects, only adults of *C. granaria* at the bottom of the bin were still alive after two months, but immature stages survived at all points, over 50 per cent. doing so at the bottom of the bin. Concentrations of phosphine were highest in the upper parts of the bins, and little or no gas could be detected at the bottom; concentrations were considerably lower than in the large silos, and more gas may have been sorbed on the grain, though bread prepared from the wheat was not tainted and the oats were not unpalatable to cattle. The effectiveness of phosphine was compared with that of a mixture of carbon tetrachloride and ethylene dichloride (1:1) in a similar test in bins, each with a capacity of about 25 tons, constructed of overlapping aluminium sections. Two bins containing barley and one containing oats, all infested by *O. surinamensis* and with temperatures of 51–56°F., were treated. Tablets were applied to the oats and one bin of barley at rates of 13 and 10 per ton, respectively, by dropping them down gas-piping (1-inch bore) inserted at evenly spaced points, and the bins were then covered with gas-proof sheets. The surface of the barley in the other bin was sprayed with 5 gal. of the mixture of carbon tetrachloride and

ethylene dichloride and covered with empty paper sacks. After an exposure of five days, both methods were found to have given excellent control of the natural infestation as well as substantial control of late immature stages of *C. granaria* and *C. oryzae* and larvae of *T. granarium* in cages. Fumigation with phosphine is therefore considered satisfactory for farm bins, provided that the depth of grain does not exceed 12 ft., which is about the maximum depth to which the tablets can conveniently be inserted.

In tests with infestations in small quantities of grain stored in sacks, two tablets were inserted, one as deep as possible and the other near the surface, into each of two test sacks of wheat at a temperature of about 40°F. in a group of 18 placed on a gas-proof sheet, which was subsequently wrapped over them all. Emergence in cages containing immature stages of *C. granaria* placed in the sacks was reduced from 104–127 for no treatment to 4–8 in cages in the centre of the treated sacks and 14–15 in those at the side; there was less emergence from the sack placed in the centre of the group than from one on its edge. In a similar test, 13 sacks of infested rye in a stack, in which the most important pests were *C. oryzae*, *Cryptolestes ferrugineus* (Steph.), *O. surinamensis*, *R. dominica*, *Tribolium castaneum* (Hbst.) and *Glycyphagus* sp. and a predacious mite, *Cheyletus* sp., was also present, were treated with two tablets each, and the stack was wrapped in a gas-proof sheet. Complete control of the insects in the natural infestation was obtained after five days and maintained for an observation period of five weeks, but a few mites, representing three species, were present after a month; the test insects, comprising adults of *Calandra granaria*, *O. surinamensis*, and *Palorus ratzeburgi* (Wissm.) and larvae of *Tenebrio molitor* L., were also killed.

AHMED (M. K.). **Life-history and Feeding Habits of *Paederus alfierii* Koch (Coleoptera: Staphylinidae).**—*Bull. Soc. ent. Egypte* **41** pp. 129–143, 25 figs., 9 refs. Cairo, 1957.

The adults of *Paederus alfierii* Koch are important predators of *Prodenia litura* (F.) on cotton in Egypt [*cf. R.A.E.*, A **41** 415; **45** 398]. The immature stages of this Staphylinid are described, and an account is given of observations on its bionomics carried out in the laboratory. The eggs were laid singly in decaying vegetable matter or damp soil, and hatched in about three days in summer at 30°C. [86°F.] and 70 per cent. relative humidity and in about 16 days in winter. There were two larval instars, the first lasting 5 days in summer and 11 days in winter, and the second 8 and 18 days, respectively. The larvae were active and hid in the soil. The prepupal stage lasted 1 and 5 days and the pupal stage 3·5 and 15 days in summer and winter, respectively. The adults emerged at night and remained in the soil for a day before moving to plants. Females were four times as numerous as males. Adults kept under outdoor conditions lived for about four months in summer and for six months when emergence occurred in December; if food was not available, they died about two days after emergence.

In feeding trials, the larvae accepted only Collembola and refused small earthworms, mites, aphids and eggs of *P. litura*, although fully-grown larvae sometimes attacked first-instar larvae of their own species, as also did the adults. The adults fed more widely, and accepted *Aphis gossypii* Glov., *A. durantae* Theo., eggs and larvae of *P. litura*, eggs of *Earias insulana* (Boisd.) and *Agrotis ypsilon* (Hfn.) and honey. The average number of eggs of *P. litura* eaten daily was 28·6, as compared with 17·7 for the larger eggs of *E. insulana*. First-instar larvae of *P. litura* were preferred to older larvae, an average of 24·2 being eaten per day, third-, fourth- and fifth-instar

larvae were eaten only in the absence of earlier stages, and sixth-instar larvae were not attacked at all. Eggs and first-instar larvae of *P. litura* were preferred to *Aphis gossypii* or eggs of *E. insulana*.

Hassan (M. S.). **Studies on the Morphology and Biology of** *Aphis maidis* **Fitch., in Egypt (Hemiptera-Homoptera: Aphididae).**—*Bull. Soc. ent. Egypte* **41** pp. 199–211, 26 figs., 6 refs. Cairo, 1957. **Studies on the Damage and Control of** *Aphis maidis* **Fitch., in Egypt (Hemiptera-Homoptera: Aphididae).**—*T. c.* pp. 213–230, 22 figs., 13 refs.

Aphis maidis Fitch has of recent years become a serious pest of maize, barley, wheat and sorghum in Egypt. In the first of these two papers, the nymphs and the apterous and alate viviparae of this aphid are described and an account is given of observations on its bionomics. Alates were found throughout the year, but were most numerous in late February, March, September and early October, increasing in numbers when conditions became unfavourable for the apterae. The effects of plant dryness were demonstrated in the laboratory in November 1948, when 12·3 per cent. alates developed in populations reared on fresh barley leaves renewed daily and 81 per cent. on leaves that remained unchanged for periods of 10 days. Although the aphids throve and reproduced on seedlings of barley, wheat and sugar-cane and on the tender leaves of mature plants, including maize and sorghum, they survived for only 3–7 days on maize or sorghum seedlings.

The life-history of *A. maidis* was studied in the laboratory from February 1944 to January 1945, maize leaves being used for food in summer and barley leaves in autumn, winter and spring; the food was changed daily. The apterae reached the reproductive stage after 13 days in December, 15 days in January, 9 days in March and 6 days in September and October, whereas alates required about 1–3 days more. The duration of life, which was inversely related to temperature, was 52, 16 and 20 days in January, June and September, respectively. Apterae produced 3–67 nymphs each and alates 8–28; the average daily rate of production was usually 1–6, but was sometimes higher (7–9) for apterae in March–April and September–October. Development was continuous, and up to 45 generations were produced in the year, ranging in duration from 6 days in summer and early autumn to 20 days in winter. No males occurred [*cf. R.A.E.*, A **20** 674]. The optimum temperature for development lay between 25·3 and 28·9°C. [77·54 and 84·02°F.], and average body lengths were greater at 13°C. [55·4°F.] than at 24°C. [75·2°F.]. Temperatures of at least 39°C. [102·2°F.] and 42°C. [107·6°F.] caused complete mortality of alates and apterae, respectively [*cf.* **22** 150].

The second paper is concerned with *A. maidis* in the field. Its wild and cultivated food-plants in Egypt are listed; with the exception of *Polygonum*, all are graminaceous, but it was only once found on sugar-cane. A few aphids migrated from weeds to barley in late December, and larger numbers to wheat in mid-January, giving rise to the first of the annual peaks of infestation in late March and April. Migration to weeds occurred when barley and wheat finished earing, followed by a movement to sorghum in May and early June and then again to weeds or to summer maize. *Panicum colonum* was the most favoured plant in June–July. Maize, sorghum and weeds were infested between late August and October, when the second population peak occurred. Periods of infestation varied with locality. In the Delta, maize was infested from early September to November, first on the tassels and later on the cobs, but in Upper Egypt the infestation did not begin until early October. Sorghum was infested in April–June and from mid-August to November in the Delta and Middle Egypt, and in September–

December in Upper Egypt. Wheat and barley were infested in December–March in Upper Egypt, from late January to April in Middle Egypt, and in February–April in the Delta. The symptoms of the injury are described. The loss of yield of maize was estimated at 5–10 per cent. from grain counts in Menufia and Caliubia provinces in September, and the yield was increased by an average of 7·2 per cent. by weight at Matana in 1943 by a spray of nicotine sulphate and soap. Tests in 1942–49 showed that early sowing diminished the attack on barley, wheat and maize, but affected the yield of maize. The cutting of not more than 25–30 per cent. of severely-infested maize tassels increased yields somewhat, and sprays of 0·1–0·15 per cent. nicotine sulphate and soap killed 10–100 per cent. of the aphids, depending on the stage of development of the crop, but were not justified by the resultant increases in yield.

The aphid is checked by various natural enemies, but they appear too late in the season to prevent the development of large populations. Coccinellids were the most numerous of the predators, especially *Coccinella undecimpunctata* L. and *Scymnus* spp.; adults and larvae of *C. undecimpunctata* ate averages of 34 and 17 aphids per day, respectively, in a test. Other predators comprised Anthocorids (*Orius albidipennis* (Reut.) and *O. laevigatus* (Fieb.)), *Chrysopa vulgaris* Schneider, Syrphids (*Syrphus corollae* F., *Xanthogramma aegyptium* (Wied.), *Sphaerophoria flavicauda* Zett. and *Paragus aegyptius* Macq.), *Leucopis puncticornis aphidivora* Rond., and an unidentified Cecidomyiid. The most important parasite was an Encyrtid, *Aphidencyrtus aphidivorus* (Mayr), parasitism by which rose from 3 per cent. in early September to 90 per cent. in late November. *Aphidius sonchi* Marshall parasitised 10–20 per cent. of the aphids in April, and *Praon flavinode* (Hal.) occurred still less frequently.

Khalifa (A.). **The Development of Eggs of some Egyptian Species of Grasshoppers, with a special Reference to the Incidence of Diapause in the Eggs of *Euprepocnemis plorans* Charp. (Orthoptera: Acridiidae).** —*Bull. Soc. ent. Egypte* **41** pp. 299–330, 7 figs., 36 refs. Cairo, 1957.

The following is based on the author's summary. The conditions necessary for embryonic development in some Egyptian species of grasshoppers were studied in relation to soil moisture and the relative humidity of the air between soil particles. The eggs of *Aiolopus* spp. absorb the required amount of water from a saturated atmosphere, but those of *Eyprepocnemis plorans* (Charp.) require actual contact with water in order to develop beyond the stage of anatrepsis (the initial stage in blastokinesis), even when kept at a relative humidity of 80–100 per cent. The embryonic development of *E. plorans* is described. Eggs deposited in wet soil in summer or autumn and maintained in it under room conditions absorbed water and hatched in the following spring, but those deposited in dry soil remained alive for nearly a year at a stage prior to anatrepsis, resuming development when water was made available. Water absorption and increase in weight occur mainly during anatrepsis. *E. plorans* lays both diapause and non-diapause eggs. At 28°C. [82·4°F.], nearly 80 per cent. of the eggs were found to enter diapause at anatrepsis, with the incubation period varying from 69 to 259 or more days, but non-diapause eggs hatched in 40–60 days at the same temperature. Most eggs did not enter diapause when they were exposed to 8°C. [46·4°F.] for 30 days at anatrepsis. The chorion and hydropyle were found to be impermeable to a solution of iodine for three days after egg deposition and again during diapause; at other times they were permeable. There is no diapause in *Aiolopus*.

Ezzat (Y. M.). **Biological Studies on the Olive Scale,** *Parlatoria oleae* **(Colvée) (Hemiptera-Homoptera: Coccoidea-Diaspididae).**—*Bull. Soc. ent. Egypte* **41** pp. 351–363, 11 figs., 9 refs. Cairo, 1957.

Observations on the life-history of *Parlatoria oleae* (Colv.) on privet (*Ligustrum ovalifolium*) in the laboratory and in the open in Maryland [*cf. R.A.E.*, A **18** 395] were made in 1951. There were two generations a year, the second overwintering from September as the adult females, which began to lay eggs in the following April. The incubation period of the spring generation varied from about 26 days in May at an average temperature of 66·7°F. to 22 days in July at 78·8°F., and that of the autumn generation from about 22 days in July to about a month in October. Egg mortality was about 1·5 per cent. The duration of the first nymphal stage ranged from 5·7 days at 80·2°F. to 25 days at 72·5°F. There was a mortality of 24·2 per cent. during this stage, 15·9 per cent. occurring before emergence from beneath the parent scale. The duration of the second female stage was also inversely correlated with temperature, being 15 days at 80°F. and 31 days at 71°F. The period of oviposition lasted about 70 days in both generations; most of the eggs were laid in May and June by the overwintered females and in July and August by those of the spring generation, which deposited about 65 eggs each. The males passed through prepupal and pupal stages, during which there was about 14·3 per cent. mortality; they were found at all times in July–October and were twice as numerous as females. The males also developed normally on squash fruits in the laboratory, but the scales of the females were unusually thin.

Ezzat (Y. M.). **Egg-laying and Hatching Habits of** *Magicicada septendecim* **(Linné) (Hemiptera-Homoptera: Cicadidae).**—*Bull. Soc. ent. Egypte* **41** pp. 365–370, 4 figs., 3 refs. Cairo, 1957.

Adults of *Magicicada septendecim* (L.) emerged on 10th May in Maryland in 1953 [*cf. R.A.E.*, A **43** 40], and eggs laid in incisions on the twigs of trees and shrubs in the middle of that month hatched mostly between 12th and 23rd July, the date varying with the plant.

Nakhla (N. B.). **The Life-history, Habits, and Control of the Bersim Grasshopper,** *Euprepocnemis plorans* **Charp., in Egypt (Orthoptera: Acridiidae).**—*Bull. Soc. ent. Egypte* **41** pp. 411–427, 9 figs., 8 refs. Cairo, 1957.

Euprepocnemis plorans (Charp.) is the most important of the grasshoppers that damage field crops in Egypt, and its bionomics and control were investigated in 1940–45. The females are sexually mature on emergence, and the males become so after 1–2 weeks. Oviposition occurred 20–30 days after pairing, and each female usually deposited three egg-pods, containing 30–50 eggs each, about 1·5 in. beneath the soil surface. Under laboratory conditions, the eggs hatched in three weeks in moist sand in early summer and in 4·5–5 months in late summer and autumn [*cf. R.A.E.*, A **47** 311], the nymphal stage lasted 56–63 days in summer, and the adults lived for 3·5–5·5 months, the females being longer-lived than the males. There were usually two generations a year, but a partial third occurred in the laboratory in 1940. In cage observations, newly-hatched hoppers did not feed for 6–24 hours and then restricted their feeding to periods when the air temperature was 19–22°C. [66·2–71·6°F.]. At higher temperatures, they climbed

the stems of plants, and at 35–36°C. [95–96·8°F.] they sheltered beneath them. Nymphs in the fourth and fifth instars and adults fed at 32–33°C. [89·6–91·4°F.]. Pairing occurred at 28–32°C. [82·4–89·6°F.], and eggs were laid preferably in bare soil or in spaces between plants. In the field, hoppers preferred to feed on ripening and drying rather than on green crops, and moved to adjacent fields when a crop was irrigated. Egyptian clover (*Trifolium alexandrinum*) and maize were the preferred food, followed by other leguminous crops (except lupin and lucerne, which were not attacked), vegetables, cotton, other cereals and sugar-cane; flax was not eaten. Higher populations of *E. plorans* have followed an increase in the cultivation of cereals, especially rice, and in the acreage of reclaimed land. Some mortality of adults was caused by natural enemies, but the main environmental factor reducing the population was high temperature associated with high relative humidity, which affected the young nymphs; 71·5 per cent. of hoppers died in the first instar, and only 3·1 per cent. became adults, in cage tests in which the maximum temperature reached 103°F. and the relative humidity 78 per cent.

In tests of bran baits, carried out in cages, good results were given against first-instar hoppers by 0·5 per cent. sodium arsenite (80 per cent. active ingredient). This was as effective as 1–2 per cent., which is recommended against all instars, but 3 per cent. proved repellent. More rapid, but no more effective, results were given by 4 per cent. sodium fluosilicate; barium chloride was of value in baits only when freshly prepared. Formulations of 10 and 50 per cent. DDT, used at 2–5 per cent., were unsatisfactory. BHC at 2–3 per cent. of a material containing 20 per cent. mixed isomers was equal to sodium arsenite and killed more rapidly; the bait served as a contact poison for hoppers of the first three instars. In preliminary tests, emulsion concentrates containing 12 per cent. γ BHC or 60 per cent. aldrin were satisfactory in bran baits at rates of 0·5–1 and 0·2–0·5 per cent., respectively. No increased kill was shown by the use of wet instead of dry baits, but the former were easier to distribute, remained longer on the ground, and were preferred at high temperatures. Poison baits are unsatisfactory under some conditions, and dusts should then be used. BHC dusts were the best of those tested; they persisted for up to 15 days, were more effective against adults than against fourth- and fifth-instar hoppers, and gave complete kill in 24 hours in some tests.

El-Nahal (A. K. M.). **Toxicity of Carbon Bisulphide to** *Sitophilus granaria* **L.,** *Sitophilus oryzae* **L.,** *Tribolium confusum* **Duv., and** *Rhizopertha dominica* **Fab., under reduced Pressure (Coleoptera: Curculionidae, Tenebrionidae, and Bostrychidae).**—*Bull. Soc. ent. Egypte* **41** pp. 457–465, 4 graphs, 12 refs. Cairo, 1957.

In fumigation tests in which adult insects were exposed for two or four hours in 10-litre jars at 28°C. [82·4°F.] to selected concentrations of carbon bisulphide, *Calandra* (*Sitophilus*) *granaria* (L.), *C.* (*S.*) *oryzae* (L.) and *Tribolium confusum* Duv. showed higher mortality when fumigation was carried out under a sustained vacuum (pressure 4 cm. mercury) than at atmospheric pressure [*cf. R.A.E.*, A **42** 39–40, etc.]. The difference was greatest for *C. oryzae* and least for *C. granaria*, and a similar gradation was found when adults were exposed to reduced pressure in the absence of fumigant. *Rhizopertha dominica* (F.) was less susceptible to carbon bisulphide under reduced pressure, owing possibly to some effect on respiratory behaviour.

Ezzat (Y. M.) & Highland (H. A.). **The Effect of certain Insecticides on Oxygen Consumption of a Mealybug (Hemiptera-Homoptera: Coccoidea-Pseudococcidae).**—*Bull. Soc. ent. Egypte* **41** pp. 473–476, 3 graphs, 2 refs. Cairo, 1957.

In a study of the physiological action of Systox (diethyl 2-(ethylthio)ethyl phosphorothioate [demeton]) on *Pseudococcus maritimus* (Ehrh.) when applied to rooted cuttings of *Euonymus*, the consumption of oxygen by the mealybug, as determined by the Warburg manometric method, was 2–5 times as great as normal when material containing 0·1 g. active ingredient per 100 ml. was used as a soil drench. Oxygen consumption was slightly lower than normal after the plants had been sprayed to run-off with an emulsion spray of malathion at the same concentration. Demeton still caused a slight but significant increase in respiration when applied at lower concentrations (0·005–0·05 g. per 100 ml.).

Maher Ali (A.). **The Food Plant and the Biology of** *Leptoxyda longistylus* **(Wied.) in Egypt (Diptera: Trypanaeidae).**—*Bull. Soc. ent. Egypte* **41** pp. 485–487, 10 refs. Cairo, 1957. **On the Bionomics of** *Dacus ciliatus* **Loew (Diptera: Trypanaeidae).**—*T. c.* pp. 527–533, 6 figs., 6 refs.

Dacus (*Leptoxyda*) *longistylus* Wied. has been stated to attack cucurbits in Egypt [*R.A.E.*, A **39** 301], but field and laboratory investigations, described in the first paper, showed that this Trypetid is restricted to *Calotropis procera* and that the species infesting cucurbits is *Dacus ciliatus* Lw. [*cf.* **44** 301].

Observations on the life-history and control of *D. ciliatus* are recorded in the second paper. Except for the north of the Delta and the Canal Zone, the Trypetid occurs throughout Egypt on cultivated cucurbits; peaks of infestation occur in February–May and September–October in Upper and Lower Egypt, respectively, and overwintering takes place on the wild *Colocynthis vulgaris* (*Citrullus colocynthis*), which is very common. Pairing occurs after hibernation, and the females oviposit as soon as cucurbit fruits are present; 5–50 eggs are laid per female, and they hatch in 3–4 days. The larvae tunnel within the fruit and become fully grown in 15–18 days, when they usually leave the fruit and pupate in the soil; pupation within the fruits was rare. The pupal stage normally lasts for three weeks, but is prolonged at low temperatures or in soil that is not well aerated. The adults feed on nectar or honeydew as soon as they have emerged and then pair; there is a pre-ovipositional period of six days. Clean cultivation and the elimination of *C. vulgaris* are necessary adjuncts to the chemical control of *D. ciliatus*, since the frequent picking and rapid marketing of such crops as cucumbers makes the use of residual insecticides hazardous. In preliminary trials in 1955, plots of cucumbers isolated by guard rows of a cereal were sprayed with 3 per cent. DDT alone or with 3 per cent. lindane [almost pure γ BHC]. DDT alone reduced the percentage infestation from 12·5 to 8·05 when applied to the guard rows only and to 5·42 when applied to the plots as well, and control was not improved by the addition of γ BHC.

Maher Ali (A.). **On the Bionomics and Control of the Bean-fly,** *Agromyza phaseoli* **Coq. (Diptera: Agromyzidae).**—*Bull. Soc. ent. Egypte* **41** pp. 551–554, 3 refs. Cairo, 1957.

Melanagromyza (*Agromyza*) *phaseoli* (Coq.) is a widespread pest of beans in Egypt [*cf. R.A.E.*, A **38** 450]. The larvae mine the leaves on plants of

all ages, tunnel through the petioles and main stems and pupate either in the soil or within the stems if robust plant tissues are encountered. Adults are active throughout the day, but avoid direct sunlight at noon. Populations varied widely from day to day in light-trap catches in 1955, but the lowest numbers were recorded between late November and late March. In experiments on control in 1954, a spray of 0·3 per cent. chlordane applied six times at ten-day intervals was significantly superior to other treatments; 0·09 per cent. diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] alone or with 0·2 per cent. DDT was the next best.

El-Nahal (A. K. M.) & El-Borollosy (F. M.). **The relative Toxicity of Carbon Disulphide to the different Larval Instars and Pupae of** *Corcyra cephalonica* **Stain. and** *Ephestia kuehniella* **Zeller (Lepidoptera: Pyralidae).**—*Bull. Soc. ent. Egypte* **41** pp. 555–576, 15 graphs, 30 refs. Cairo, 1957.

The relative susceptibilities of free larvae of *Corcyra cephalonica* (Stnt.) and *Anagasta* (*Ephestia*) *kühniella* (Zell.) in all six instars and of pupae in or out of their cocoons to fumigation with carbon bisulphide were determined. The tests were carried out in aspirators of about 5 l. capacity at 28°C. [82·4°F.], and the exposure period was four hours. Larvae or pupae were transferred at the conclusion of each test to tubes or jars containing wheat bran, counts were made after six days of the numbers of larvae that had transformed to the next instar or stage, and after nine days of the numbers of pupae that had given rise to adults, and the true kill was ascertained by Abbott's formula [*R.A.E.*, A **13** 331]. It was apparent from the LD50's and LD95's obtained that the larvae of both species were more susceptible to carbon bisulphide during the greater part of their development than were the pupae, and that their susceptibility decreased with successive instars. There were also changes in susceptibility within each instar, larvae being less susceptible at the end of an instar than at its beginning, but pupae were less susceptible two days after pupation than after seven days, with little difference due to the presence of the cocoon. *C. cephalonica* was more susceptible than *A. kühniella* in all stages, the difference becoming most marked in the later larval instars. The differences in susceptibility between the species and between larvae and pupae are discussed, with special reference to the influence of metabolic rates.

Abul-Nasr (S.) & El-Nahal (A. K. M.). **Field Tests with some new synthetic Insecticides for the Control of** *Thrips tabaci* **on Cotton Seedlings (Thysanoptera: Thripidae).**—*Bull. Soc. ent. Egypte* **41** pp. 577–589, 3 graphs, 10 refs. Cairo, 1957.

In tests of eight synthetic insecticides and nicotine sulphate for the control of *Thrips tabaci* Lind. on cotton seedlings in Egypt [*cf. R.A.E.*, A **40** 136], sprays were applied in 1956 to quarter-acre plots at 150 l. [33 gal.] per acre on 26th March and 12th April, at the beginning and end of the first generation, and again three weeks later, at the end of the second generation. Counts of nymphs were made on 20 plants selected at random 1–10 days after the first application, 1–12 days after the second, and 1–16 days after the third. All the materials, except nicotine sulphate at 90 g. active ingredient per acre, gave complete control immediately after the first application, but their residual effect was variable. An emulsion spray affording 105–210 g. dieldrin per acre was the most persistent, maintaining complete control for at least 16 days at 140 g. per acre. Emulsion sprays containing

parathion, Guthion (O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate), Metasystox (dimethyl 2-(ethylthio)ethyl phosphorothioate [methyl-demeton]) and Chlorthion (O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate) were effective for about a week at rates of 35, 60, 75 and 75 g. active ingredient per acre, respectively, but one of Dipterex (dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate) at 75 g. toxicant per acre was less effective, and sprays of γ BHC giving 15 g. toxicant per acre from an emulsion concentrate or 49 g. from a wettable powder were even less persistent. Spider mites infested all plots at the end of April, and the population became highest on those sprayed with dieldrin.

Abul-Nasr (S.) & Awadalla (A. M.). **External Morphology and Biology of the Bean Pod-borer, *Etiella zinckenella* Treit. (Lepidoptera: Pyralidae).**—*Bull. Soc. ent. Egypte* **41** pp. 591–620, 15 figs., 30 refs. Cairo, 1957.

Etiella zinckenella (Treitschke), all stages of which are described, is an important pest of lima beans (both large and small varieties) and cowpeas in Egypt and also attacks *Dolichos lablab*. Crop losses at Giza in September 1953 amounted to 62·3 per cent. by weight on small lima beans and 39·5 per cent. on cowpeas, and over 40 per cent. of the pods were infested in certain areas. Infestation of *D. lablab* was about 10 per cent. In the laboratory, *E. zinckenella* was also reared on pods of *Spartium junceum*, but did not attack kidney beans, peas, or *Acacia* and *Crotalaria* spp.

The bionomics of the Pyralid were investigated in 1953–54 at Giza and other localities. The eggs hatched in 5–6 days at a mean temperature of 26·5°C. [79·7°F.]. Newly hatched larvae transferred to fresh pods of suitable plants in jars containing wet sand took 15–30 minutes to select a suitable site for entry, 20–30 minutes to spin a protective web, and 20–45 minutes to bore into the pod. Until they reached the fourth instar, the larvae fed in the seeds, but later they left these and fed freely within the pod. Cannibalism occurred when more than two occupied one pod. Although a larva may confine itself to a single seed, it more frequently damages several, and the accumulation of frass leads to rotting. The larvae became full-fed in 10–13 days on cowpeas and lima beans and in up to 17 days on *D. lablab*, and then dropped to the ground and formed cocoons about an inch below the surface and within a foot of the plant, after which they remained quiescent for periods ranging from an average of about 2 days in May–August to 72 days in winter before pupating. The pupal stage averaged 9 days at 29°C. [84·2°F.] and 61·5 days at 14·9°C. [58·82°F.], its duration varying inversely with that of the prepupal stage. All the pupae gave rise to adults in March at a mean temperature of 19·2°C. [66·56°F.], but only 87 per cent. did so in July at 29°C. and 50 per cent. in February at 17·9°C. [64·22°F.]. The numbers of males and females were about equal. The life-span of adults that had not paired and had access to sugar solution was about 8–20 days at 25·8°C. [78·44°F.], but the upper limit was reduced to 11 days for moths that had paired. Pairing took place 24–30 hours after emergence, and males fertilised only one female each. The preferred sites for oviposition were the junction of the calyx and the pod and the pod surface. Eggs were laid singly or in small groups; in the field it was rare to find more than six on a pod. The average numbers laid per female were 47–178, but they were reduced to 27–45 when food was withheld; the numbers of eggs laid daily ranged from 2 to 70.

There were 7–8 generations a year in the laboratory and about 6–7 in the field. Adults of the overwintered generation emerged in late February or early March and infested *D. lablab* and *Spartium*; after 1–2 generations,

early cowpeas and lima beans were lightly infested during May–July by a further 1–2 generations, and late crops were severely attacked in August–October by another 1–2. In November, the larvae either entered the quiescent phase or pupated; some adults emerged during warm spells in November–January and oviposited on *D. lablab*, but the majority of the population overwintered in the cocoon stages. Damage to cowpeas was more severe in late crops than in early ones, and low populations on cowpeas were correlated with high populations on lima beans. The only parasite observed was the Ichneumonid, *Ephialtes* (*Pimpla*) *roborator* (F.), which attacked the larvae late in the year.

Jarczyk (H. J.), Jarczyk (M.) & Flaschentraeger (B.). **Contribution to the Biology and Biochemistry of the Cotton Leaf-worm,** *Prodenia litura* **F. I. Investigations on the Duration of the Pupal Stage and on the Emergence and its Relation to the Daytime of Female and Male Moths.**—*Bull. Soc. ent. Egypte* **41** pp. 621–626, 4 graphs, 13 refs. Cairo, 1957.

In laboratory studies on *Prodenia litura* (F.), carried out at Alexandria in 1956 at a relative humidity of 60–70 per cent., the pupal stages of males and females were found to average 9 and 7·5 days at 25–26°C. [77–78·8°F.] and 7·5 and 6·5 days at 28–29°C. [82·4–84·2°F.], respectively. Female moths emerged between 11 a.m. and midnight, with peak emergence at 4–6 p.m., at the lower temperature range, and between midday and 3 a.m., with a peak at 6 p.m., at the higher range. The periods and peaks of emergence for males were about three hours later, but emergence ceased at midnight at the higher temperatures.

Proceedings of the Tenth International Congress of Entomology, Montreal, August 17–25, 1956. Section on Agricultural Entomology.—*Proc. 10th int. Congr. Ent.* **3** pp. 3–493. Ottawa, 1958.

The following are abstracts of selected papers containing hitherto unpublished information of which the text is printed in full in this section [*cf. R.A.E.*, A **47** 265, etc.].

Hagen (K. S.). **Honeydew as an Adult Fruit Fly Diet affecting Reproduction,** pp. 25–30, 1 graph, 28 refs. The following is substantially the author's abstract. When adults of *Dacus dorsalis* Hend. were fed on the honeydew excreted by *Planococcus citri* (Risso) or on diets containing enzymatic protein hydrolysates of either yeast or soy bean, the resulting fecundity and fertility were comparable to those induced by a formulated purified diet. Experimental determinations of the gross nutritional requirements suggested that honeydew contains carbohydrates, hydrolysed protein, minerals and certain B-group vitamins. *Anastrepha ludens* (Lw.) also deposited eggs when fed on honeydew, but not when supplied with a carbohydrate alone. It is suggested from these results and a review of the literature that the honeydew excreted by Homoptera is complex, and that various Trypetids probably seek it as a natural food.

Maramorosch (K.). **Studies of Aster Yellows Virus Transmission by the Leafhopper Species** *Macrosteles fascifrons* **Stål and** *M. laevis* **Ribaut,** pp. 221–227, 26 refs. The following is substantially the author's abstract. The specificity of transmission of the virus of aster yellows was investigated in tests with *Macrosteles fascifrons* (Stål) from the United States and *M. laevis* (Ribaut) from Europe. Colonies of uninfected insects were reared on cereals, and 200 of each species were fed for two weeks on plants infected

with either the Eastern or the California strain of the virus. The insects were then tested in groups of 3–5 per plant on young China asters (*Callistephus chinensis*) for two or more weeks. None of 80 plants exposed to *M. laevis* became infected, whereas *M. fascifrons* transmitted the Eastern strain to 38 of 40 and the California strain to 23 of 40 plants. No progeny resulted from attempted reciprocal crossings, and it is concluded that these two Cicadellids, which are placed by taxonomists in the *fascifrons* complex [*cf.* **41** 322] on the basis of their male genitalia, constitute separate sibling species. The tests indicated that the degree of specificity in the transmission of the virus is relatively high, and that the belief that the introduction into Europe of plants infected with American aster yellows would result in the spread of the disease by *M. laevis*, which is the common aster leafhopper there, seems unwarranted. The nature of the specificity is not understood, but there are indications that it is caused by barriers to virus multiplication in the insects and by barriers to the penetration of the gut wall and the salivary glands. The Eastern and California strains of aster yellows have been shown by L. O. Kunkel to protect against each other in plants and in *M. fascifrons*, but no similar data are available for other yellows-type viruses. The ability of several species of Cicadellids to transmit aster yellows does not contradict the concept of specificity; the search for vectors of typical yellows-type viruses can probably be limited at present to this family.

Fox (C. J. S.). **Some Effects of Insecticides on the Wireworms and Vegetation of Grassland in Nova Scotia,** pp. 297–300, 4 refs. In experiments on the control of the larvae of *Agriotes mancus* (Say), *A. sputator* (L.), *A. lineatus* (L.) and *A. obscurus* (L.), carried out on grassland in four localities in Nova Scotia in 1952–56, applications of 3–6 lb. aldrin in an emulsion concentrate, 0·75–1 lb. wettable lindane [almost pure γ BHC] or 8 lb. wettable chlordane in 116 gal. spray per acre, without subsequent cultivation, resulted in increased yields and quality of hay and reduced weeds; γ BHC caused high wireworm mortality within eight months, but permitted considerable repopulation after 28 months, whereas aldrin and chlordane caused high mortality more slowly, with no repopulation until the fourth year. When applied in the same way, 6 lb. aldrin, dieldrin and heptachlor per acre gave 30–40 per cent. control of Collembola and 10–21 per cent. control of Acarina.

Miller (L. A.) & McClanahan (R. J.). **Seed Dressings for Control of Maggots and Diseases attacking certain Field and Vegetable Crops in southern Ontario, 1956,** pp. 301–306, 6 refs. The following is substantially the authors' abstract. Control of *Hylemyia cilicrura* (Rond.), the most injurious soil pest of peas, maize, beans and cucurbits in southern Ontario, was obtained by coating the seeds of these crops with a mixture of 0·4 oz. heptachlor, dieldrin or lindane [almost pure γ BHC] with 1·5 oz. thiram [bis(dimethylthiocarbamoyl) disulphide] or captan [N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide] per 100 lb. A seed dressing containing an insecticide alone was sometimes ineffective. On cooking onions, smut (caused by the fungus, *Urocystis cepulae*) and *Hylemyia antiqua* (Mg.) were effectively controlled with a dressing containing 2 oz. thiram and 1 oz. heptachlor or dieldrin per lb. seed. The amounts of protectants remaining on the seed coats after germination are discussed, and it is suggested that the sowing rates for many crops should be reviewed in the light of the increased protection afforded by seed dressings.

van 't Sant (L. E.). **Control of Carrot Fly (*Psila rosae* F.) with Chlordane in Holland,** pp. 321–323, 3 refs. As adults of *Psila rosae* (F.) are present in carrot fields in Holland over long periods, insecticides with a long-lasting effect are desirable to protect the crop. Chlordane applied at 0·03 oz. per sq. yard as a dust mixed with sand, broadcast over the soil surface and worked into the top two inches, gave satisfactory control on short-crop

carrots, with a growing period of three months. A single application protected two successive crops, remaining effective for at least 6–7 months. On long-crop carrots, with a growing period of about six months, treatment with 0·06 oz. chlordane per sq. yard gave good control of a medium infestation and 0·13 oz. of a heavy one, without affecting the taste or leaving harmful residues.

DE FLUITER (H. J.) & VAN DER MEER (F. A.). **The Biology and Control of *Macropsis fuscula* Zett., the Vector of the *Rubus* Stunt Virus,** pp. 341–345, 7 refs. The authors review the life-history of *Macropsis fuscula* (Zett.), which has been shown to transmit a virus that causes dwarfing of *Rubus* in Holland [*cf.* **42** 368] and is increasing in importance on cultivated raspberry. The adults of this Cicadellid spread the virus from old plantations to new ones in August and September and are evidently very active and able to cover long distances. Preliminary experiments indicated a rather long latent period and a persistence of the virus in the vector. Spread was reduced by sprays of 6 per cent. tar distillate or 0·4 per cent. DNC, applied in January or early February against the eggs of *M. fuscula*, by sprays of 0·1 per cent. parathion or diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] or 0·2 per cent. malathion, applied twice in late May and the first half of June against the young nymphs, or by spraying first-year plantings with 0·1 per cent. parathion or Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] once a fortnight from the beginning of August to kill infected adults. The virus also occurs in wild blackberries, and as *M. fuscula* can breed and mature on several species of these, they can evidently serve as a source of infection for cultivated raspberry; the insect failed to survive on cultivated blackberry. *M. scotti* Edw. occurs on one cultivated and certain wild species of blackberries, but it is not known whether it transmits the virus.

MELTZER (J.). **Acaricidal Properties of 2,4,5,4′-Tetrachloro-diphenyl Sulphone (Tedion),** pp. 347–351, 2 figs., 3 refs. In laboratory tests, Tedion (2,4,5,4′-tetrachlorodiphenyl sulphone), which kills the immature stages of *Tetranychus telarius* (L.) (*urticae* Koch) [*cf.* **45** 334], did not affect the fecundity of females confined on sprayed leaves, whereas CPBS (p-chlorophenyl benzenesulphonate) caused a considerable decrease in the number of eggs laid per day. Neither compound significantly reduced the life-span of the females, but both of them and also chlorbenside (p-chlorobenzyl p-chlorophenyl sulphide) affected the viability of the eggs developing in the ovaries; the females laid sterile eggs for several days after contact with plants treated with Tedion, but the effect was far less pronounced with CPBS and chlorbenside. When the upper leaf surface was treated with Tedion and the mites were confined on the lower surface, females transferred after three days to untreated plants also laid sterile eggs for several days; CPBS had far less effect under these conditions and chlorbenside hardly any.

SIMÓN F. (J. E.). **Experimentos con insecticidas sistémicos en el algodón Tangüis del Perú** [Experiments with Systemic Insecticides on Cotton in Peru], pp. 357–362, 9 figs., 3 refs. Observations in Peru in 1951–56 showed that sprays containing 0·015 per cent. Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] or 0·03 per cent. Metasystox [dimethyl 2-(ethylthio)ethyl phosphorothioate (methyl-demeton)] effectively reduced populations of *Empoasca* sp. on cotton, the second being more rapid and lasting in its effect. *Leucothrips theobromae* (Priesn.) was not controlled by 0·1 per cent. methyl-demeton applied on 7th or 21st February or 10th or 20th March 1956, but tests with higher concentrations showed that a 0·15 per cent. spray gave about 50 per cent. control. The 0·1 per cent. spray killed *Oligonychus* (*Paratetranychus*) *peruvianus* (McG.) in four days, but did not give satisfactory control of a species of *Pinnaspis*, and neither compound was effective against *Planococcus* (*Pseudococcus*) *citri* (Risso), even when applied

at high rates by spraying, by watering or by soil injection. Against *Aphis gossypii* Glov., demeton gave good control for 4–5 weeks and methyl-demeton excellent control for 6 weeks. Thimet [O,O-diethyl S-ethylthio-methyl phosphorodithioate], applied to the soil as a dust on activated carbon, was as effective against the aphid as the methyl-demeton spray.

Kuwayama (S.). **The Smaller Rice Leaf-miner, *Hydrellia griseola* Fallén, in Japan,** pp. 399–405, 10 refs. The following is based on the author's abstract. *Hydrellia griscola* (Fall.) has been a serious pest of rice in Japan since 1933, especially in the northern temperate regions, such as Hokkaido and the Tohoku district of Honshu. Investigations on the life-history of this Ephydrid showed that it has 5–8 generations a year, of which the second occurs on rice and the others on wild grasses. In Hokkaido, adults begin to emerge from the overwintered pupae in late April or early May. The egg, larval and pupal stages last about 1, 2 and 2 weeks, respectively, in June–July, and the adult female lays 20–30 eggs on leaf blades lying on the water surface, surviving for 5–18 days. The larvae mine the leaves and pupate in the feeding mines or in mines made on other plants. Generations may overlap by two weeks. *H. griseola* is adapted to fairly low temperatures, and the plants damaged by it comprise 46 species of 32 genera in four families. Graminaceous plants predominate, but whereas both larval and pupal mines occur in Monocotyledons, only pupal mines are made in Dicotyledons. Hymenopterous parasites of 14 species in five families were reared from *H. griseola* in 1954, *Opius* sp. and *Chorebus* sp. being the most important. Severe outbreaks of *Hydrellia* are dependent on weather conditions and other environmental factors. Low temperatures in the preceding summer result in an increase in numbers in autumn, and higher temperatures than usual during winter, accompanied by an early thaw, contribute to low mortality of the increased populations. Relatively high temperatures in early spring and low temperatures from May to July provide favourable conditions for development and increase, and synchronism between the oviposition period, the transplanting of rice seedlings, deep water in the rice-fields and slow weak growth of the plants because of low temperatures lead to increased damage. Such a combination does not ordinarily occur, but almost all these conditions were present in 1954 and resulted in the worst outbreak known. Of the recommended control measures, dusting with 1–3 per cent. γ BHC against the adults and newly hatched larvae is fairly effective, but a 1·5 per cent. parathion dust or a 0·09 per cent. dieldrin emulsion spray is more satisfactory against the older larvae. Cultural practices, including correct water management and the transplanting of vigorous seedlings at the optimum period, afford additional control.

Szent-Ivany (J. J. H.). **Insects of cultivated Plants in the Central Highlands of New Guinea,** pp. 427–437, 4 refs. The following is based on the author's abstract. Of 92 insects found on cultivated plants in the highlands of New Guinea in recent years and here listed, 72 represent new economic records for the Territory and 69 for the South Pacific Island Area. Ten species of Coleoptera are considered major pests. These are the Melolonthid, *Lepidiota vogeli* Brenske, larvae of which attack the roots of grasses; the Dynastid, *Papuana* sp., of which the adults injure cabbage, potato, strawberry and turnip; *Cylas formicarius* (F.), which attacks sweet potato; and *Apirocalus cornutus* Pasc., *Aulacophrys facialis* Mshl., *Oribius destructor* Mshl., *O. hostis* Mshl. [*cf.* **45** 215] and three other weevils (all unidentified) that injure coffee.

Kato (S.). **The Turnip Maggot and other Species of *Hylemyia* (Diptera: Muscidae) of economic Importance in Japan,** pp. 445–447, 12 refs. In Hokkaido, *Hylemyia floralis* (Fall.) is the most injurious pest of radish and also attacks Chinese cabbage severely. *H. pilipyga* (Villen.) attacks early varieties of radish in early summer and autumn. *H. antiqua* (Mg.) is found

in scattered localities in almost all provinces except the central area of Honshu and frequently causes serious damage to onion in Hokkaido, Tohoku and Chugoku. It has 2–3 generations a year, with peaks of emergence in mid-June and late August, in Hokkaido and three distinct generations, with aestivation in the soil between peaks of adult emergence in mid-June and early October, in Oita. *H. cilicrura* (Rond.) (*platura*, auct.) is widely distributed, with 2–3 generations a year, throughout Japan and sometimes causes severe damage to cucurbits, cereals and some vegetables. Control measures are noted.

Washburn (R. H.). *Taeniothrips orionis* **Leh., a Thrips destructive to Vegetables in Alaska.**—*J. econ. Ent.* **51** no. 3 p. 274, 2 refs. Menasha, Wis., 1958.

In the summer of 1954, *Taeniothrips orionis* Treherne caused severe damage to lettuce and potato in the neighbourhood of Kenai, Alaska; it was controlled on potato with DDT. Damage was not observed in 1955 or 1956, but the thrips severely injured cabbage, lettuce and potato in the same general area in August 1957. Previous records indicate that *T. orionis* feeds mainly on wild plants, and this appears to be an instance of a native insect that changed its feeding habits when cultivated crops were introduced into a newly cleared area.

Morris (R. F.). **Biology and Control of the Purple-backed Cabbageworm in Newfoundland.**—*J. econ. Ent.* **51** no. 3 pp. 281–284, 7 figs., 6 refs. Menasha, Wis., 1958.

The following is based largely on the author's abstract. *Evergestis pallidata* (Hfn.), of which *E. straminalis* (Hb.) is a synonym, was first reported in Newfoundland in 1943 and is now considered a major pest of cruciferous crops throughout the Province. This Pyralid has only one generation a year, overwinters in the prepupal stage in an earthen cocoon at or near the soil surface and pupates in June. The adults emerge in late July and deposit egg-masses on the lower surfaces of the lower leaves of susceptible plants. The larvae hatch in 4–8 days and pass through four instars, averaging about 9, 9, 10 and 26 days, respectively. No parasites were reared from field-collected larvae. In 1951, a spray of 1 lb. 50 per cent. wettable DDT per 50 gal. water, applied at 125 gal. per acre, and a 3 per cent. DDT dust, applied at 25–35 lb. per acre, gave 90 and 83 per cent. reduction in population, respectively, on turnip. One application is sufficient if made when the first egg-masses are beginning to hatch. On cabbage that is within a few days of being harvested, 25–35 lb. 1 per cent. derris dust should be used; this gave 76 per cent. reduction in numbers of larvae. Deep, thorough and frequent cultivation during late autumn and early spring destroys the cocoons, and autumn ploughing helps to destroy the overwintering larvae by burying them more deeply.

Selhime (A. G.). **Dieldrin for Control of Fuller Rose Beetle attacking potted** *Citrus* **Trees in a Greenhouse.**—*J. econ. Ent.* **51** no. 3 p. 284. Menasha, Wis., 1958.

Pantomorus godmani (Crotch) became a serious pest in a greenhouse at Orlando, Florida, in the summer of 1957, the adults feeding heavily on the foliage and the larvae on the roots of *Citrus* trees in pots. On 14th August, a spray of 1 lb. 25 per cent. wettable dieldrin per U.S. gal. was diluted with

water (1 : 30) and applied with the watering hose to give fair coverage of the foliage and to drench the soil in the pots; about 24 dead beetles were found the next day and 5–12 per day for several weeks. A spray of 2 lb. 15 per cent. wettable parathion, 1 U.S. quart 57 per cent. emulsifiable malathion and 1 U.S. quart 43·7 per cent. emulsifiable Trithion [O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate] per 100 U.S. gal. water was applied to the plants against Coccids and spider mites on 8th November, and dead and dying beetles were still found occasionally for a few weeks. No plant injury due to the sprays was observed.

Andres (L. A.) & Reynolds (H. T.). **Laboratory Determination of organophosphorous Insecticide Resistance in three Species of *Tetranychus* on Cotton.**—*J. econ. Ent.* **51** no. 3 pp. 285–287, 2 figs., 11 refs. Menasha, Wis., 1958.

Demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] failed to control *Tetranychus atlanticus* McG. and *T. pacificus* McG. on cotton in two places in California in the early summer of 1956, and mites were therefore collected in these areas and compared with others, from fields in which control had proved satisfactory, for susceptibility to parathion, Trithion [O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate], Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] and Kelthane [1,1-di(p-chlorophenyl)-2,2,2-trichloroethanol]. Colonies were established on lima-bean plants and treatments made by immersing infested leaves for four seconds in known concentrations of toxicant in emulsions prepared from xylene solutions with Triton X-100 as the emulsifier. Living and dead adult females were counted 24 hours later. From the mortality curves, it was apparent that both *T. atlanticus* and *T. pacificus* from the test areas had developed considerable resistance to parathion, less to Trithion and none to Kelthane or Aramite, though the slightly higher LC50's of these compounds for the resistant strain of *T. pacificus* may have been correlated with resistance to organic phosphorus compounds.

A single test with *T. cinnabarinus* (Boisd.), made because of reported failure of control on cotton in 1957 in the Coachella valley, indicated a development of resistance to phosphorus compounds comparable with that in the other two species.

Vanderzant (E. S.) & Davich (T. B.). **Laboratory Rearing of the Boll Weevil: a satisfactory larval Diet and Oviposition Studies.**—*J. econ. Ent.* **51** no. 3 pp. 288–291, 3 refs. Menasha, Wis., 1958.

A technique is described whereby *Anthonomus grandis* Boh. was reared from egg to adult through five generations in the laboratory on a diet containing soy-bean protein, sucrose, maize oil, cholesterol, choline, vitamins, yeast extract, salts, cellulose, alginate, agar and water, with developmental periods of 12–20 days. When the resulting females were allowed to feed and oviposit on cotton squares, they laid an average of three and a maximum of seven eggs per day over 30 days. They also fed and oviposited on cotton cotyledons, but less readily; the cotyledons apparently do not afford such concentrated food as the squares, and so result in a lower production of eggs. Weevils were reluctant to feed on mature cotton leaves, did not oviposit on them and died within two weeks. Field-collected weevils fed on the artificial diet, but did not oviposit unless extractives of cotton plants were added. Oviposition occurred on squares with or without bracts and on squares that had been ground up, remoulded and coated with paraffin.

Long (W. H.) & Lilly (J. H.). **Wireworm Behavior in Response to Chemical Seed Treatments.**—*J. econ. Ent.* **51** no. 3 pp. 291–295, 2 figs., 11 refs. Menasha, Wis., 1958.

In the experiments described, larvae of *Melanotus communis* (Gylh.) were tagged with pieces of radioactive cobalt (^{60}Co) by a technique similar to one already noticed [*R.A.E.*, A **44** 238] and allowed to enter pots of soil containing maize seeds that had been mixed with wettable powders of aldrin, dieldrin, endrin, heptachlor or lindane [almost pure γ BHC], with the addition of methyl cellulose and a fungicide. Eight observations per day of each insect's position were made at 2-hourly intervals for 6–8 days with a Geiger-Müller tube, and it was found that when the wireworms were offered a choice of untreated seed and seeds treated with 0·5, 1 or 2 oz. of different insecticides per bushel, they could often successfully reach and feed on the untreated seed and seemed to avoid feeding on or maintaining contact with seeds treated with γ BHC; their ability to detect and avoid those treated with the other materials was less apparent. When offered only untreated seed and seed treated with 1 oz. per bushel of a single insecticide, the larvae avoided remaining for long near seed treated with γ BHC; they also avoided seed treated with aldrin, though they had seemed unable to move from seed treated with 2 oz. aldrin in the first experiment. Both tests indicated that aldrin had the most pronounced effect in inhibiting random movement. No larvae were found to have fed on treated seeds, but some fed on untreated ones. The cobalt tag was removed after each test, and comparison of the average length of life of treated and untreated larvae indicated no harmful effect due to the radioactive cobalt, but some larvae showed deformation of the caudal segment, near the site of tagging.

It is concluded that the repellency of insecticide seed treatments to wireworms is the resultant of two components, inhibition of the feeding reaction and orientation of the insects away from treated seeds. All five insecticides tested appeared to possess considerable repellency of the first kind, whereas the second was most pronounced in γ BHC and was characteristic of aldrin at rates of 0·5–1 oz. per bushel; 2 oz. aldrin apparently had an immediate toxic effect, inhibiting movement from the seed.

Hall (I. M.) & Dunn (P. H.). **Susceptibility of some Insect Pests to Infection by *Bacillus thuringiensis* Berliner in Laboratory Tests.**—*J. econ. Ent.* **51** no. 3 pp. 296–298, 4 refs. Menasha, Wis., 1958.

In view of the possible commercial production of spores of *Bacillus thuringiensis* for insect control, the susceptibility of several important leaf-chewing insect pests of southern California to the bacillus was tested in the laboratory to provide guidance for field experiments [*cf.* *R.A.E.*, A **40** 154]. The insects were fed on leaves that had been thoroughly wetted in a suspension of spores, with the addition of a wetting agent if necessary, and infection was determined by microscopic examination of dead individuals. Larvae of *Estigmene acraea* (Dru.), *Bucculatrix thurberiella* Busck, *Udea* (*Phlyctaenia*) *rubigalis* (Gn.), *Amorbia cssigana* Busck, *Heliothis zea* (Boddie) and *Hypera brunneipennis* (Boh.) and adults of the last were found to be at least moderately susceptible to the bacillus, larvae of *Trichoplusia ni* (Hb.), *Laphygma exigua* (Hb.) and *Platynota stultana* Wlsm. were less so and larvae of *Haltica* (*Altica*) *ambiens* Lec. and larvae and adults of *Galerucella luteola* (Müll.) (*xanthomelaena* (Schr.)) were only slightly susceptible [*cf.* **45** 263]. In a preliminary test, first-instar larvae of *Sabulodes caberata* Gn. refused to feed on treated leaves and died of starvation, while development was normal on untreated material. In some tests with *Laphygma* and

Heliothis larvae and *Hypera* adults, mortality was much higher than could be attributed to infection with the bacillus, and a toxic effect was thought to have been induced by it.

Oatman (E. R.). **Sour Cherries infested with Butterfly Chrysalids.**—*J. econ. Ent.* **51** no. 3 p. 298, 1 fig. Menasha, Wis., 1958.

Objects found attached to harvested Montmorency cherries during canning operations in Wisconsin in 1957 were identified as the pupae of several species of butterflies, including *Danaus plexippus* (L.), the only one determined.

Saunders (J. P.) & Bay (E. C.). **Resistance of some rodenticidal Baits to Infestation by *Tribolium confusum* Duv.**—*J. econ. Ent.* **51** no. 3 pp. 299–302, 3 figs., 6 refs. Menasha, Wis., 1958.

In view of the danger of spreading insect pests of stored grain by the use of rodent baits consisting of maize meal and anticoagulants [*cf. R.A.E.*, A **42** 187], warfarin [3-α-acetonylbenzyl-4-hydroxycoumarin], 2-phenyl-1,3-indandione and 11 2-acyl-1,3-indandiones were compared with DDT for ability to kill adults and prevent larval development of *Tribolium confusum* Duv. in maize-meal baits containing them. When adults were allowed to feed for seven days on the bait mixtures, 0·2 per cent. DDT gave complete kill, 0·5 per cent. Pival (2-pivalyl-1,3-indandione) 76 per cent., 0·1 and 0·05 per cent. Pival 16–49 per cent. and the other compounds none. Seven days after the adults had been removed, no larvae were found in baits containing 0·2 per cent. DDT, Pival, 2-acetyl-1,3-indandione or 2-isovaleryl-1,3-indandione [*cf.* B **32** 156], and reduced numbers in those containing 0·5 per cent. 2-propionyl-1,3-indandione or 2-heptanoyl-1,3-indandione. All the other compounds were ineffective.

del Rosario (M. S.) & Sill jr. (W. H.). **A Method of rearing large Colonies of an Eriophyid Mite, *Aceria tulipae* (Keifer), in pure Culture from single Eggs or Adults.**—*J. econ. Ent.* **51** no. 3 pp. 303–306, 2 figs., 6 refs. Menasha, Wis., 1958.

Since *Aceria tulipae* (Keifer) is too small to be reared by standard cage techniques, a special method was developed whereby colonies of the mite could be reared from one or more field-collected eggs or adults. Large colonies were consistently obtained by keeping the mites in a humid environment, particularly while the colonies were becoming established, and by transplanting whole infested plants rather than by moving individual mites. The mites were allowed to hatch on wheat leaves in petri dishes lined with moist filter paper and were then transferred to young wheat plants that were moved to progressively larger cages as they and the mite colonies developed. The cages successively used consisted of test-tubes, lamp globes, and larger nylon taffeta or glass-cylinder cages. When the mites became abundant, high humidity, although desirable, no longer appeared essential. Flooding for 24 hours or more, as a result of condensation, was detrimental and eventually lethal.

The best method of transferring individual eggs and mites was by means of medium-coarse human hair. The mites were negatively phototropic, and groups could readily be made to move by directing a bright light at them from a distance of 5 in. or less, but this method was relatively slow and it was difficult to count the numbers involved. Transfer by inserting a portion of infested leaf into the leaf axil of an uninfested plant was not very

effective, as the mites did not always leave the transferred portion and often died when it withered.

Waites (R. E.) & Van Middelem (C. H.). **Residue Studies of DDT and Malathion on Turnip Tops, Collards, Snap Beans and Lettuce.**—*J. econ. Ent.* **51** no. 3 pp. 306–308, 2 graphs, 10 refs. Menasha, Wis., 1958.

In tests on the amounts of residue likely to be found after treatment with emulsion sprays of DDT or malathion on some of the leafy vegetables grown in Florida, turnips were sprayed on 28th November and 5th and 10th December 1953, kale (collards) and lettuce on 2nd and 10th February 1956 and, for comparison, snap beans on 20th and 30th May 1955, all at about 100 U.S. gal. per acre. Turnip tops sprayed with 10·1, 20·2 and 30·3 oz. malathion per acre bore malathion residues of only 1·3, 2·1 and 4·5 parts per million four hours after the last application, and kale sprayed with 16 oz. malathion 2·6–3·9 p.p.m. after three days; no tolerance has been established for malathion on this crop, but 8 p.p.m. is permitted on others. Kale and lettuce sprayed with 16 oz. DDT per acre showed residues of 28·8–34·5 and 17·2–19·6 p.p.m. after three days, but the average was less than the tolerance of 7 p.p.m. after 14 days; the pods of snap beans sprayed with 12 oz. DDT had 0·8 p.p.m. residue after one day.

Vanderzant (E. S.). **The Amino Acid Requirements of the Pink Bollworm.** —*J. econ. Ent.* **51** no. 3 pp. 309–311, 18 refs. Menasha, Wis., 1958.

The following is based on the author's abstract. The growth and development of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) on media containing various amino acids as a source of nitrogen are described. Optimum development was observed on a medium with an amino-acid mixture based on the composition of cottonseed protein. Ten amino acids were found to be indispensable, but growth was slow and the resulting adults were small on a medium containing these alone. The inclusion of certain dispensable amino acids was necessary for optimum growth and development.

Stern (V. M.) & Reynolds (H. T.). **Resistance of the Spotted Alfalfa Aphid to certain Organophosphorus Insecticides in southern California.** —*J. econ. Ent.* **51** no. 3 pp. 312–316, 1 graph, 13 refs. Menasha, Wis., 1958.

The following is substantially the authors' abstract. During the late summer of 1956, reports were received in increasing numbers of the failure of parathion and malathion to control *Therioaphis maculata* (Buckt.) on lucerne in southern California. A survey of the area indicated the presence of a resistant strain of the aphid, and field tests showed that a low degree of resistance to parathion and also to Trithion [O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate] had developed in localised areas. In one test, sprays of malathion, Phosdrin [dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate] and demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] gave only mediocre control when applied at 9·1, 0·7 and 0·9 oz. toxicant per acre, respectively, whereas the same dosages gave excellent control of susceptible populations elsewhere. Laboratory tests showed that the aphid had developed an approximately four-fold resistance to parathion residues, and possibly even more if time from exposure to mortality were considered. Resistant aphids continued to reproduce when exposed to the toxicant, and many of the young survived, whereas reproduction in non-resistant aphids was markedly reduced, and the young died. It is pointed out in a discussion

that the development of resistance to an insecticide does not progress in the same manner in parthenogenetic as in bisexual species. The mechanism is presumably mutation followed by selection. Mutation probably occurred after the aphid had arrived in North America in 1953 [*cf. R.A.E.*, A **45** 11], since resistance was not observed until 1956. There is some evidence that it may also have appeared in Texas [*cf.* **46** 175].

Riehl (L. A.), Wedding (R. T.), LaDue (J. P.) & Rodriguez jr. (J. L.). **Effect of a California Spray Oil on Transpiration of** *Citrus*.—*J. econ. Ent.* **51** no. 3 pp. 317–320, 9 refs. Menasha, Wis., 1958.

The following is substantially the authors' abstract. The effect of a representative California foliage spray oil, applied according to current field practice for the control of *Citrus* pests, on transpiration in plants of several varieties of *Citrus* was investigated in laboratory experiments. Plants of Eureka lemon, Bearss lime, navel orange and Valencia orange were grown in pots in the greenhouse; temperature control permitted a maximum of 92°F. during the day and a minimum of 66°F. during the night. Transpiration was measured by determining the loss in total weight of the potted plant during a period of seven hours from morning to afternoon; the surface area of the foliage was measured and transpiration was expressed as mg. water transpired per sq. cm. leaf surface per hour. On the first day after the application of a 1·75 per cent. oil emulsion, transpiration was reduced to one-third of that on untreated plants. Oil-sprayed plants recovered with time, and analyses showed that the correlation with the logarithm of time was highly significant. The available evidence indicates that reduction in transpiration in *Citrus* foliage after the application of an oil spray is due to physical interference by the oil on or in the leaf tissue and that recovery of transpiration occurs with dissipation of the oil from the leaves. Transpiration reached its original level in the oil-sprayed plants 3–5 weeks after the spray had been applied.

Robbins (W. E.), Hopkins (T. L.) & Roth (A. R.). **Application of the colorimetric whole-blood Method to the Measurement of bovine red-blood-cell Cholinesterase Activity.**—*J. econ. Ent.* **51** no. 3 pp. 326–329, 4 graphs, 10 refs. Menasha, Wis., 1958.

The increasing use of organophosphorus insecticides for the control of insects affecting domestic animals and forage crops has resulted in the need to diagnose poisoning by these anticholinesterase agents. Since the cholinesterase activity of red blood cells can be used as an indicator of that of the nervous system, determination of it would serve as a means of diagnosing poisoning and as a tool in studies of residue ingestion and mode of action. A rapid and precise colorimetric method for the determination of bovine red-blood-cell cholinesterase activity, employing whole blood as the enzyme source, is described. It gives good agreement with the electrometric red-blood-cell method in measuring *in vivo* inhibition by organophosphorus insecticides.

Chandler (S. C.). **Plum Curculio Populations in an unsprayed Peach Orchard in southern Illinois.**—*J. econ. Ent.* **51** no. 3 pp. 330–332, 5 graphs. Menasha, Wis., 1958.

Jarring the trees once a week from blossom time almost to harvest for five years in a neglected peach orchard in southern Illinois showed that, under

natural conditions, the overwintered adults of *Conotrachelus nenuphar* (Hbst.) began to appear in late March or early April, while the trees were in flower, and were most numerous in May, 4–6 weeks after full bloom. Adults of the first generation began to appear in late June or early July; their numbers were much affected by moisture conditions during the period of pupation and emergence, and had considerable effect on the size of the next year's population. Lack of a fruit crop, whatever the weather conditions, greatly reduced the population in the following year. During two years of drought (1953–54) and one of total crop loss from frost (1955), there were many fewer adults of the first than of the overwintered generation. Total numbers jarred per season from five trees dropped from 495 in 1953 to 36 in 1956, but rose to 338 in 1957, when rainfall was heavy. Infestation at harvest followed a similar pattern, 88 per cent. of the fruits being injured in 1953, 8 per cent. in 1956 and 50 per cent. in 1957.

Gilmer (R. M.) & McEwen (F. L.). **Chlorotic Fleck, an Eriophyid Mite Injury of Myrobalan Plum.**—*J. econ. Ent.* **51** no. 3 pp. 335–337, 2 figs., 5 refs. Menasha, Wis., 1958.

The following is based on the authors' abstract. Chlorotic fleck, a foliage abnormality of myrobalan plum (*Prunus cerasifera*), is common in nurseries in New York and was found in investigations in 1956–57 to be associated with the feeding of an Eriophyid, *Vasates fockeui* (Nal. & Trt.). Although leaves of all ages were readily infested, symptoms of chlorotic fleck resulted only when the mites fed on immature leaves. About 14 days elapsed between the establishment of an infestation and the initial appearance of symptoms. Graft inoculations indicated that a virus is not involved. Excellent control of *V. fockeui* and concomitant prevention of chlorotic fleck were given under field conditions by spraying three times with demeton [diethyl 2-(ethylthio)-ethyl phosphorothioate] at intervals of about two weeks.

Glasser (R. F.), Blenk (R. G.), Dewey (J. E.), Hilton (B. D.) & Weiden (M. H. J.). **Occurrence of a toxic non-aldrin Residue in Carrots grown on Aldrin-treated Soil.**—*J. econ. Ent.* **51** no. 3 pp. 337–341, 10 refs. Menasha, Wis., 1958.

Since bioassay with *Drosophila melanogaster* Mg. and analysis by the phenyl-azide method, specific to aldrin, and the semi-specific total-chloride method gave divergent results in the determination of aldrin residues in carrots grown in soil treated with this insecticide, investigations were carried out on the cause of the discrepancy. It was confirmed that the residues indicated by the direct bioassay of the macerated carrots were significantly greater than those shown by the chemical methods. These require preliminary extraction and chromatography, and it was found that whereas direct bioassay of the carrots and bioassay of the unchromatographed extracts in Skellysolve and isopropanol gave the same result, bioassay of the chromatographed extracts gave results that agreed with those of chemical analysis, indicating that chromatography had removed part of the toxic residue. Additional chromatographic and chemical analysis showed the presence of dieldrin [*cf. R.A.E.*, A **47** 56], and biological evaluation of combinations of aldrin and dieldrin proved the validity of equating the sum of the chemically determined aldrin and dieldrin values with the direct bioassay value.

Knipling (E. B.) & Sullivan (W. N.). **The thermal Death Points of several Species of Insects.**—*J. econ. Ent.* **51** no. 3 pp. 344–346, 5 refs. Menasha, Wis., 1958.

To obtain information on the probable fate of insects and other arthropods in closed uninsulated aircraft parked in situations exposed to the sun, in which the heat may be very great, and in unrefrigerated compartments of supersonic aircraft in flight, in which friction on the outer surface may produce enough heat to kill them, various insects of agricultural or medical importance were exposed for 15–60 minutes to temperatures of 40–60°C. [104–140°F.] in an electric oven with equal distribution of heat and then observed for 24 hours. Exposure for 15 minutes resulted in complete mortality of larvae of *Epilachna varivestis* Muls. at 50°C. [122°F.], of adults of *E. varivestis*, *Popillia japonica* Newm. and *Tribolium confusum* Duv. at 55°C. [131°F.] and of adults of *Leptinotarsa decemlineata* (Say) and nymphs and adults of grasshoppers, mainly *Melanoplus femur-rubrum* (Deg.), at 60°C. Complete kills of most species were obtained with longer exposures at temperatures lower than these.

Ferguson (W. C.). **Tedion, an outstanding new Acaricide.**—*J. econ. Ent.* **51** no. 3 pp. 352–354. Menasha, Wis., 1958.

Tedion (2,4,5,4′-tetrachlorodiphenyl sulphone) is a selective acaricide that is very effective against the newly hatched larvae and nymphs of Tetranychids, with a pronounced residual action, controls their summer eggs but not the winter ones, and is slow in action against the adults [*cf. R.A.E.*, A **45** 333–334], though it causes sterility of the eggs laid by them [*cf.* **47** A 319]. It has no harmful effects on insects or plants, and studies in progress are reported showing that it is also harmless to laboratory animals.

Field tests with Tedion were carried out in the eastern United States with a 25 per cent. wettable powder; the spray quantities given are per 100 U.S. gal. When applied to Valencia orange in Florida on 19th March, the powder at 1 lb. gave a slow kill of adults of *Panonychus citri* (McG.) present at the time of treatment, but excellent control of eggs, young larvae and nymphs for at least 54 days, whereas 0·66 lb. 45 per cent. wettable Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] gave complete kill of all active stages within 24 hours and good control for 38 days. In New York, the powder gave good control of *Tetranychus telarius* (L.) on greenhouse roses for about 50 days at 1 lb. and for 42 days at 0·5 lb. One application at 0·5 lb. in the early period of migration of *T. telarius* to apple trees gave good control for the rest of the season and was as effective as two applications at an interval of eight days or one at double the strength. The standard treatment of 1·5 lb. 15 per cent. wettable Aramite also gave good control. When applied to apple at the pre-pink stage, the Tedion powder at 1 lb. gave good control of *P. ulmi* (Koch) and *T. telarius* for 82 days, and 0·5 lb. was almost as effective; one application at the lower rate at the pre-pink stage followed by another at the ten-day stage practically eliminated both mites for the season, and an additional application at the time of the second cover spray gave no further benefit.

Dickinson (B. C.). **Ethion, a promising new Acaricide and Insecticide.**—*J. econ. Ent.* **51** no. 3 pp. 354–357. Menasha, Wis., 1958.

In field tests of ethion (O,O,O′,O′-tetraethyl S,S′-methylene bisphosphorodithioate) on apple in New York in 1956–57, a spray of 2 lb. 25 per

cent. wettable powder per 100 U.S. gal. gave good control of *Rhopalosiphum fitchii* (Sand.) (apple-grain aphid [*cf. R.A.E.*, A **46** 178]) and *Anuraphis roseus* Baker when applied at the dormant or delayed-dormant stage, and one of 1 lb. per 100 U.S. gal. controlled *Panonychus ulmi* (Koch) when applied at the pre-pink or early post-bloom stage and *Tetranychus telarius* (L.) when applied in mid-season. The higher concentration in all post-bloom sprays controlled *Cydia* (*Carpocapsa*) *pomonella* (L.) as well as did standard treatments with lead arsenate, DDT or parathion. Lower concentrations were not commercially effective against any of these pests, and the material was unsatisfactory against *Aphis pomi* Deg., *Conotrachelus nenuphar* (Hbst.) and *Argyrotaenia* (*Eulia*) *velutinana* (Wlk.).

Wolfenbarger (D. O.). **Serpentine Leaf Miner: Brief History and Summary of a Decade of Control Measures in south Florida.**—*J. econ. Ent.* **51** no. 3 pp. 357–359, 3 refs. Menasha, Wis., 1958.

Infestation of vegetables in southern Florida by Agromyzid leaf-miners referred to as *Liriomyza pusilla* (Mg.) [*cf. R.A.E.*, A **45** 406] was unimportant before 1945 but became common in 1947 and later years. Experiments on control on potato and tomato were begun in 1946, and the results obtained up to 1957 with numerous insecticides in sprays are reviewed [*cf.* **38** 30; **43** 218]. It is stated in the author's abstract that some of the chlorinated-hydrocarbon insecticides, such as chlordane, lindane [almost pure γ BHC], toxaphene and aldrin, were effective in initial experiments, but became ineffective after 1–3 seasons. Some of the phosphorus insecticides, such as parathion, EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate] and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] gave outstanding protection, but there was some evidence that parathion was less effective after ten years than initially, and diazinon is now recommended for control.

Dean (H. A.) & Schuster (M. F.). **Biological Control of Rhodes-grass Scale in Texas.**—*J. econ. Ent.* **51** no. 3 pp. 363–366, 14 refs. Menasha, Wis., 1958.

The following is based largely on the authors' abstract. Investigations were begun in southern Texas in February 1954 on the biological control of *Antonina graminis* (Mask.), of which *A. indica* Green is now considered to be a synonym, on range grasses. It was found that *Anagyrus antoninae* Timb., which was introduced from Hawaii [*cf. R.A.E.*, A **39** 400], attacks it to varying degrees at different times and places. The parasite was recovered in a drought area at Kingsville only after repeated releases between October 1955 and January 1956. In several places in the Lower Rio Grande Valley, parasitism decreased during April and became scarce during the summer months. The greatest parasitism occurred in October–March, and the parasites were most prevalent during periods in which temperatures seldom reached 90°F. Low relative humidity in the summer and autumn of 1956 was considered an important factor responsible for low parasite activity in the autumn. *Marietta graminicola* Timb. was usually found in samples of *Antonina* in November–February, and laboratory tests indicated that its primary host was *Anagyrus antoninae*. Parasites of grass-infesting Coccids introduced from France included *A. diversicornis* Merc. and *Timberlakia europaea* (Merc.), which were released in the field, but no recoveries were made. Several predacious insects and mites were found to attack the Coccid, and several other Encyrtids were observed [*cf.* **40** 288], including

A. graminicolens Doz., a female of which emerged from a sample of the scale collected in October 1954; this species had not previously been recorded in the United States.

NEISWANDER (R. B.). **The Distribution and Control of Bagworms in Ohio.** —*J. econ. Ent.* **51** no. 3 pp. 367–368, 4 refs. Menasha, Wis., 1958.

Thyridopteryx ephemeraeformis (Haw.), which formerly occurred mainly in the southern half of Ohio [*cf. R.A.E.*, A **38** 436], has apparently extended its range to the north of the State in the last 20 years. Populations vary greatly from year to year, and damage, which is greatest on ornamental arborvitae [*Thuja*] and juniper [*Juniperus*], tends to occur in cycles. The eggs of this Psychid overwinter within the bags in which they are laid and hatch in the second half of May in the south and in the first half of June in the north of the State. Each larva constructs its own bag as soon as it hatches. When it becomes fully grown, usually in August, it attaches the bag to a twig and pupates within it, transforming to the adult about four weeks later. Females do not leave the bags until they have laid the overwintering eggs.

Spraying with lead arsenate gives effective control while the larvae are small, but not when they become larger, in July and August, and damage is first noticed. In 1950, sprays were applied in late July and early August, when the larvae were large but still feeding, and normal concentrations of parathion, EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate], DDT or toxaphene appeared to be less effective than lead arsenate. In 1956, applications of 2 quarts 57 per cent. malathion, 1 quart 25 per cent. parathion and 2 quarts 47·5 per cent. Thimet [O,O-diethyl S-ethylthiomethyl phosphorodithioate] per 100 gal. emulsion spray on 24th August resulted in 92·7, 78 and 61·9 per cent. mortality, as compared with 7·1 per cent. for no treatment, and in 1957, 2 lb. 50 per cent. wettable dieldrin per 100 U.S. gal. gave 92·6 per cent. kill when applied in late July, while the larvae were still feeding, and 81 per cent. on 2nd August, when they had stopped, whereas 1 quart 57 per cent. emulsifiable malathion gave over 90 per cent. mortality on both dates; 4 lb. lead arsenate and 4 lb. 25 per cent. wettable malathion per 100 U.S. gal. caused about 87 and 81 per cent. mortality, respectively, in late July, and it is concluded that dieldrin is somewhat more effective than lead arsenate against well-grown larvae that are feeding and that malathion will kill most larvae even when feeding has stopped. Thimet and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] were relatively ineffective.

RODRIGUEZ (J. G.). **The Comparative NPK Nutrition of *Panonychus ulmi* (Koch) and *Tetranychus telarius* (L.) on Apple Trees.**—*J. econ. Ent.* **51** no. 3 pp. 369–373, 4 graphs, 15 refs. Menasha, Wis., 1958.

The following is substantially the author's summary. In greenhouse tests carried out under controlled conditions in 1956–57, apple trees were grown in nutrient solutions containing nitrogen and phosphorus at various levels and potassium at a fixed level, females of *Panonychus ulmi* (Koch) and *Tetranychus telarius* (L.) were transferred to leaves detached from them [*cf. R.A.E.*, A **42** 101] and the resulting progeny were counted. Analyses of foliage were made for total nitrogen, phosphorus and potassium, and statistical analysis of the results of these and of the mite counts showed that increasing the nitrogen content of the solution from 20 to 200 parts per million caused significant increases in the numbers of both species; increasing it to 800

p.p.m. resulted in a further increase of *T. telarius* during one season. The development of both species was positively related to absorbed nitrogen, but this relation was significant only for *T. telarius*. Earlier work showed a negative correlation between absorbed nitrogen in tomato foliage and development of *T. telarius* [*cf.* **40** 386] at levels of absorption about twice as high as those of the apple trees in these tests. In apple foliage, unlike that of tomato, nitrogen and phosphorus showed antagonism, particularly when the nitrogen supply was increased, and the amount of absorbed nitrogen was negatively correlated with the population of *T. telarius* when the phosphorus supply was increased. A tendency appeared for development of *T. telarius* to be correlated with absorbed phosphorus, positively at concentrations below 0·2 per cent. and negatively at higher ones [*cf.* **43** 216], and it is concluded that interrelations among the ions and different ranges of absorption account for seemingly contradictory effects on mite populations.

Individual variability in reproduction rates made it necessary to deal with large populations of mites in order to draw firm conclusions, and wide percentage differences in populations are required for statistical significance. In this respect, *T. telarius* reacted with more sensitivity and less variability than *P. ulmi* to changes in element supply and absorption.

The tests showed that *T. telarius* multiplies more rapidly than *P. ulmi*, under the same conditions. *T. telarius* appears to react favourably to wider ranges of nitrogen absorption, and it follows that it could do further damage to foliage after some bronzing by *P. ulmi* has occurred.

Bartlett (B. R.). **Laboratory Studies on selective Aphicides favoring natural Enemies of the Spotted Alfalfa Aphid.**—*J. econ. Ent.* **51** no. 3 pp. 374–378, 1 fig., 8 refs. Menasha, Wis., 1958.

Parathion failed to give persistent control of *Therioaphis maculata* (Buckt.) on lucerne in southern California in 1956, in spite of satisfactory initial kill, and as this was believed to be due to destruction of natural enemies, laboratory investigations on the differential toxicities of insecticides to the aphid and its principal parasites and predators were carried out in 1957.

With a few exceptions, adults of parasitic Hymenoptera are at least as susceptible as their hosts to contact insecticides, and it was shown that sprays of schradan, nicotine sulphate and demeton [diethyl 2-(ethylthio)ethyl phosphorothioate], that destroyed 95 per cent. of *T. maculata* in 24 hours, killed 68, 78 and 96 per cent., respectively, of the adults of *Praon palitans* Mues. Further tests, in which adults of *P. palitans*, *Trioxys utilis* Mues. and *Aphelinus semiflavus* How. (all recently imported internal parasites of the aphid) were caged with day-old residues, showed that they were most susceptible to malathion, parathion and Phosdrin [dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate], moderately so to lindane [almost pure γ BHC], rotenone, toxaphene and BHC, and only slightly so to TEPP [tetraethyl pyrophosphate], demeton and nicotine sulphate; schradan was not tested. The survival of 93, 59 and 12 per cent. of the pupae of *A. semiflavus* and of 59, 16 and 18 per cent. of those of *P. palitans* when sprays containing 0·125 lb. demeton, 0·63 lb. parathion and 0·5 lb. malathion per U.S. gal. water were applied to mummified host bodies showed that a variable but significant number of parasite pupae would survive direct treatment with standard field dosages of current aphicides, and that the preservation of the parasites would depend primarily on whether the toxic residues persisted until the adults emerged. Since the period of development from prepupa to adult is about a week under optimum conditions, this period is taken as the maximum period of residual toxicity compatible with parasite survival.

Coccinellids are effective predators of *T. maculata* at high host densities, and tests with adults of *Hippodamia quinquesignata* (Kby.) and larvae of *H. convergens* (Guér.) showed that, at the LD95 for a strain of the aphid susceptible to parathion, nicotine sulphate caused least destruction of the Coccinellids, followed progressively by schradan, demeton, Trithion [O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate], Phosdrin, pyrethrum extract, TEPP, γ BHC, BHC, toxaphene, parathion, malathion and rotenone. Phosdrin was the most toxic to the aphid, followed by demeton, parathion, Trithion, malathion, schradan, TEPP, γ BHC, nicotine sulphate, BHC, toxaphene and pyrethrum extract, in that order; rotenone could not be evaluated because of the high dosages necessary for 95 per cent. aphid destruction. Of the materials showing the greatest differential selectivity favouring *Hippodamia*, demeton was considered the most promising; the necessary amounts of nicotine sulphate and schradan are too high for economic use on lucerne, and the persistence of Trithion is so great that the survival of Hymenopterous parasites would be unlikely.

Asquith (D.). **Spray Combinations for Control of the Codling Moth and the Red-banded Leaf Roller on Apple.**—*J. econ. Ent.* **51** no. 3 pp. 378–379. Menasha, Wis., 1958.

In southern Pennsylvania, *Cydia* (*Carpocapsa*) *pomonella* (L.) and *Argyrotaenia velutinana* (Wlk.) attack apple fruits from their formation almost to harvest, and experiments were therefore carried out in 1957 to test certain insecticides and combinations of insecticides for their control and to compare the effects of two fungicides, captan [N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide] and glyodin [2-heptadecyl glyoxalidine acetate], on them. Sprays were applied fortnightly from 3rd June to 13th August, when the second and third generations of *Argyrotaenia* were present and *Cydia* activity was at its maximum. The insecticides used were wettable powders, unless otherwise indicated, and spray quantities are given per 100 U.S. gal.

With either fungicide, all the insecticides gave considerable control of *C. pomonella*. With captan, significantly better control than that given by DDT alone was afforded by 1·5 lb. 50 per cent. DDT with 1 lb. 15 per cent. Guthion [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate]; by 2 lb. 15 per cent. Guthion, 50 per cent. Sevin [1-naphthyl N-methylcarbamate] or 25 per cent. ethion [O,O,O′,O′-tetraethyl S,S′-methylene bisphosphorodithioate]; by 0·5 lb. 75 per cent. Chipman R-6199 [hydrogen oxalate salt of O,O-diethyl S-2-(diethylamino)ethyl phosphorothioate]; and by 1·5 lb. 50 per cent. DDT with 1·33 U.S. pints of an emulsion concentrate containing 2 lb. Phosdrin [dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate] per U.S. gal. With glyodin, the first three were better than DDT alone. All materials but ethion gave better control with glyodin than with captan, though the differences were generally not significant.

With captan, significant control of *A. velutinana* was given by mixtures of 1·5 lb. 50 per cent. DDT with 1 lb. 15 per cent. Guthion or 50 per cent. TDE (DDD) and by 2 lb. 15 per cent. Guthion or 50 per cent. Sevin. With glyodin, it was given by the same four and also by 0·5 lb. Chipman R-6199, the mixture of DDT and Phosdrin and 2 lb. ryania, this last with the addition of lead arsenate in the first four sprays, malathion in the last two and DDD in the last one. DDT alone was ineffective. Against this insect, the insecticides were more effective with glyodin than with captan, significantly so in five instances, but only Guthion with glyodin was more effective than the mixture of DDT and DDD with captan.

Chipman R-6199 and ethion, which were effective against *C. pomonella*,

gave poor results against *A. velutinana*, but Guthion and Sevin gave outstanding control of both. Glyodin caused a greater improvement in the performance of the less effective insecticides than of the better ones.

Lichtenstein (E. P.). **Movement of Insecticides in Soils under leaching and non-leaching Conditions.**—*J. econ. Ent.* **51** no. 3 pp. 380–383, 1 graph, 16 refs. Menasha, Wis., 1958.

The following is based on the author's abstract. In 1954, aldrin at 20 and 200 lb. and lindane [almost pure γ BHC] and DDT each at 10 and 100 lb. were applied to plots of a silt loam and a muck soil in about 300 U.S. gal. emulsion spray per acre with a sprinkling can and tilled into the soil to a depth of 4–5 in. Examination 17 months later showed that 84–96 per cent. of the insecticide recovered was in the upper three inches, 4–12 per cent. at a depth of 3–6 in. and 0–5 per cent. at 6–9 in. in the loam soil, whereas 62–74 per cent. was in the top layer, 19–29 per cent. in the second and 7–8 per cent. in the bottom layer in the muck soil. No differences were noticed between insecticides, but γ BHC was unequally distributed horizontally. Three years after treatment, plots sloping at angles of 5–15° contained 1·3–2·2 times as much insecticide in the lower as in the upper half of the area.

Laboratory experiments showed that γ BHC was leached to some extent from treated downwards to untreated soil; the leaching was most noticeable in sandy soil and least so in muck soil. Under non-leaching conditions, it also moved downwards into untreated soil, but more was retained in the muck soil than in the sandy one. Tests with radioactive parathion (containing ^{32}P) under non-leaching conditions showed that this compound moved in all directions in a period of six days, apparently more rapidly in the sandy than in the muck soil, 6·6 and 10·8 per cent. of the parathion recovered being in the untreated layers adjacent to the treated one and 3·5 and 1·8 per cent. in the most distant ones in the two soils, respectively. Preliminary experiments with aldrin under non-leaching conditions indicated that this insecticide is also subject to considerable movement in the soil.

Gunther (F. A.), Blinn (R. C.), Carman (G. E.) & Pappas (J. L.). **Relation of Structure of Diphenylmethane Derivatives to Toxicity to *Tribolium confusum* Duv.**—*J. econ. Ent.* **51** no. 3 pp. 385–390, 3 figs., **5 refs.** Menasha, Wis., 1958.

Experiments are described in which 44 compounds related to diphenylmethane were compared for toxicity to *Tribolium confusum* Duv. They were mixed with samples of flour at 0·2–5 per cent. by weight, and the beetles were confined with these for 24–360 hours in the dark at 76°F. From the subsequent counts, values for the LD50 and LT50 (median lethal time) were derived. Two types of toxicity were detected, diphenylmethane killing very rapidly at high concentrations, but having little toxicity at low ones, and DDT killing much more slowly, but having considerable toxicity even at the lowest concentration. The LT50 values indicated that rapid toxicity of the former type was inversely proportional to the chain length and degree of substitution of the aliphatic portion of the molecule; toxicity appeared to be associated with the presence of chlorine or hydrogen on the aromatic portions and was decreased by methyl substitution at those sites. The LD50 values showed that toxicity of the second type occurred in compounds with a greater degree of aliphatic substitution, as in the diphenylethanes. From the results with other miscellaneous compounds related to diphenylmethane, it is concluded that toxicity of the first type was possessed by compounds with an

aliphatic-substituted aromatic system. Replacement of benzene ring systems by other aromatic systems did not appreciably alter the toxicity relations.

Dresner (E.). **Biological Control Agents and Toxicant producing Plants introduced into Indonesia.**—*J. econ. Ent.* **51** no. 3 pp. 390–391, 2 refs. Menasha, Wis., 1958.

This paper includes an account of work in which various insects and micro-organisms were introduced into Indonesia in 1954–57 for investigations on the control of insect and other pests. None has so far become established. *Teleonemia scrupulosa* Stål was collected in Java and liberated in Timor in December 1954 for the control of *Lantana* [*cf. R.A.E.*, A **46** 159] and became established in many areas within a year.

Dogger (J. R.) & Bowery (T. G.). **A Study of Residues of some commonly used Insecticides on Alfalfa.**—*J. econ. Ent.* **51** no. 3 pp. 392–394, 6 refs. Menasha, Wis., 1958.

Hypera variabilis (Hbst.) (*postica* Gylh.) and *Therioaphis maculata* (Buckt.), which infest lucerne, have both spread into North Carolina since 1955. Heptachlor and dieldrin are effective against the former and malathion against the latter, and might be used for their control. The official tolerances for residues of these insecticides in the United States are 0·1, 0 and 8 parts per million, respectively, and tests were therefore carried out on the residues present after treatment at practical rates. The plots were treated on 13th June 1956, when the second growth had reached its greatest height of 10 in. Samples were taken 1–30 days later, and analysis showed that residues of over 0·1 p.p.m. may persist for 30 days after the application of 0·25 lb. dieldrin per acre in an emulsion spray and detectable amounts for 15 days after treatment with the same amount in a dust; that residues remained above the tolerance for 20–30 days after the application of 3–5 lb. heptachlor per acre in granules, but were below it ten days after treatment with 0·25 and 0·42 lb. per acre in an emulsion spray and dust, respectively; and that malathion residues were below the tolerance one and ten days after the application of approximately 1 lb. per acre in dust and emulsion spray, respectively.

Wolfenbarger (D.) & Hibbs (E. T.). **Onion Thrips** (*Thrips tabaci* **Lind.) infesting Cabbage.**—*J. econ. Ent.* **51** no. 3 pp. 394–396, 1 fig., 7 refs. Menasha, Wis., 1958.

Cabbage is seriously damaged in eastern Iowa by thrips. The principal species concerned is *Thrips tabaci* Lind., but four species of *Frankliniella* occur in small numbers. Trapping records showed that the thrips apparently migrated to the plants from lucerne and winter wheat, on which they reached large numbers in May and early June; the population declined sharply with the cutting of the hay in mid-June and the maturing of the wheat in early July. The thrips first appeared in large numbers in cabbage fields in the third week of June, but did not feed extensively or oviposit on the plants until the heads were beginning to form and the leaves closely pressed together. The time when this occurred varied among plants in the row, and insecticide applications were useless after the heads had formed and the thrips had become established in them.

Tests in field plots in 1956 and 1957, in which emulsion sprays were applied weekly from the beginning of heading, showed that applications of 0·5 lb. heptachlor per acre resulted in 93–94 per cent. marketable cabbages, as

compared with 61–64 per cent. for no treatment; parathion and dieldrin at 0·3 lb. per acre were next in effectiveness, and other organic compounds gave little or no protection.

It is concluded that infestation by *T. tabaci* is a potentially serious threat to cabbage production in Iowa, but that heptachlor may offer a practical means of control. Any practice that will ensure a uniform rate of cabbage development will be advantageous, as spraying should be begun at the initiation of the heading stage, before the thrips become established.

Race (S. R.) & Dobson (R. C.). **A Method for studying the Microenvironment of the Spotted Alfalfa Aphid.**—*J. econ. Ent.* **51** no. 3 pp. 397–400, 5 figs. Menasha, Wis., 1958.

During studies on *Therioaphis maculata* (Buckt.) on lucerne in New Mexico, macroclimatic records and observations failed to explain the rapid appearance and disappearance of the aphid, and it was concluded that a thorough understanding of microenvironmental influences on its activity and development was needed. An electrical instrument designed to make 12 continuous and simultaneous records of temperature or dewpoint was used from March to November 1957 to determine conditions 5 ft. above the ground and at heights of 2, 4, 7 and 11 in., within the zone of lucerne growth, in the hope of explaining and predicting outbreaks and timing control measures.

The results showed consistent differences in temperature and relative humidity at the various levels. Averages for a typical week towards the end of the season are given and discussed. Within the lucerne, the day temperature increased with height, except that it was slightly higher at 2 than at 4 in., probably because of soil radiation, and it reached its maximum at noon. The changes at sunrise and sunset were sharp at 7 and 11 in., indicating the effect of insolation, and they were the more extreme at 11 in. The night temperature was highest at 2 in. and lowest at 4 in. At 5 ft., the maximum temperature was reached at 1–3 p.m., but it was lower than that at 7 in. in the crop, and the night temperature was consistently higher than those within the lucerne.

Relative humidity was not measured at 7 or 11 in. The daily average was about 6 per cent. higher at 4 than at 2 in., principally because increased soil radiation in the night caused warmer air temperatures at the soil surface, but there was a slightly greater relative humidity at 2 than at 4 in. from 9 a.m. until 3 p.m. There was relatively little variation throughout the 24 hours at these heights. The average at 5 ft. was 36 per cent. lower than at 4 in., and there was a sharp decrease to a minimum at 2 p.m., after which there was a rapid rise, the maximum being reached at 2–6 a.m.

In general, the temperature at 5 ft. parallelled that within the lucerne but the relative humidity did not, and it is concluded that readings at 5 ft. should not be used to predict conditions in the microenvironment of the aphid.

Giese (R. L.), Benjamin (D. M.) & Casida (J. E.). **Results of Trunk Implantation of systemic Insecticides in Conifers.**—*J. econ. Ent.* **51** no. 3 pp. 400–401, 6 refs. Menasha, Wis., 1958.

Preliminary tests on the effectiveness of implanting systemic insecticides into conifers were carried out in Wisconsin. Balsam firs (*Abies balsamea*) infested by *Cecidomyia* (*Itonida*) *balsamicola* Lint., which makes galls on the leaves, were first used. The trees were about 4 in. in diameter and 17 ft. in height, and they were treated with dimefox [bis(dimethylamino)fluorophosphine oxide], demeton [diethyl 2-(ethylthio)ethyl phosphorothioate],

Thimet [O,O-diethyl S-ethylthiomethyl phosphorodithioate], Chipman R-6199 [hydrogen oxalate salt of O,O-diethyl S-2-(diethylamino)ethyl phosphorothioate] and Am. Cyanamid 12880 (O,O-dimethyl S-(methylcarbamoyl)-methyl phosphorodithioate). The insecticides were pipetted into four equidistant holes, 0·5 in. in diameter and 2 in. deep, bored into the trunk at an angle of 45° 6–12 in. above soil level, after which corks were inserted to minimise pitch exudation and loss of chemical; the first three materials were applied as the technical insecticides and the last two as 50 and 10 per cent. aqueous solutions of the technical forms, respectively, 12880 on 3rd September and all other materials on 2nd July.

Each insecticide was applied at 1 and 4 g. active ingredient per tree. Demeton at 1 g. gave complete kill of the larvae of *C. balsamicola* in three days. Dimefox was as rapid at the higher rate, but very phytotoxic even at 1 g., and the other materials were slower in action, though the results with 12880, which gave complete kill in 26 days at either rate, were not comparable with the others, as it was not used until near the end of the growing season, when a lower rate of translocation would be expected. Larvae of *Tetrastichus whitmani* (Gir.) and *T. marcovitchi* (Crwf.) continued to develop in the galls on larvae killed by 12880. For any given dose of insecticide, the time required for complete mortality was directly correlated with the diameter of the tree, and no significant difference in kill was observed between the lower, middle and upper thirds of the crown.

Demeton was further tested at 4, 2 and 0·5 g. per tree on 15th August against fourth- and fifth-instar larvae of *Neodiprion lecontei* (Fitch) placed on pine trees (*Pinus resinosa*) 10 years old. The three doses gave complete mortality in 2, 3 and 5 days, respectively.

Randolph (N. M.) & Gillespie (B. B.). **Notes on the Biology of** *Bruchus brachialis* **Fahr.**—*J. econ. Ent.* **51** no. 3 pp. 401–402, 1 graph, 2 refs. Menasha, Wis., 1958.

Bruchus brachialis Fhs. was first observed in Texas in 1953, has since spread to most of the areas in the north-east and east of the State in which vetch [*Vicia*] is grown, and is now considered one of the most important pests of the crop there. In observations on the bionomics of the Bruchid, overwintered adults were first collected in vetch fields on 13th March, about five weeks before pod formation, and eggs were laid on the developing pods from the first week of May until 20th June [*cf. R.A.E.*, A **21** 415]. Females isolated on pods in the field laid 0–19 eggs at an average rate of 8·5 per day, singly on all parts. The larvae hatched in five days in most cases, mined superficially in the pods during most or all of the first instar, and then entered the seeds. Two or more were often found mining near a developing seed, but there was rarely more than one in a seed, and never more than one beyond the second of the four larval instars. Development was completed within a single seed, and the size of the larvae, especially those in the last two instars, and of the pupae and adults, varied considerably, depending partly on the size of the seed. Development from eggs laid on 10th June to adult emergence lasted 22–48 days, with an average of 30 days; there was one generation a year.

McEwen (F. L.) & Hervey (G. E. R.). *Crambus calliginosellus* **Clem. destructive to Carrots in western New York.**—*J. econ. Ent.* **51** no. 3 pp. 402–403, 2 figs., 6 refs. Menasha, Wis., 1958.

Larvae of *Crambus caliginosellus* Clem., which had not so far proved injurious in New York, were observed in late July 1955 damaging the roots

of carrots grown in the highlands in the west of the State. The damage ranged from minor feeding marks to the excavation of an entire side, though the central core was seldom reached; feeding normally began about half an inch below the soil surface, and the larva was encased in a tubular web-lined gallery, fixed to the side of the carrot and sometimes to several carrots along a row, all of which were damaged to some extent. Webbing surrounded the larva in the root and usually covered the entrance to the feeding gallery. Injury increased as the season advanced, and about 20 per cent. of the roots were damaged before harvest in one field; inspection of other fields indicated 3–5 per cent. injury in highland carrots, but only a trace in those grown in muck areas. In 1956 and 1957, injury did not exceed 1 per cent., and there was none in most fields. Wild carrot (*Daucus carota*) has been recorded as an acceptable food-plant in Virginia [*R.A.E.*, A **2** 525], and although the status of the insect as a pest of carrot is uncertain, its ability to cause appreciable injury to the crop must be recognised.

Yust (H. R.). **Rufous Scale on Robusta Coffee in Ecuador.**—*J. econ. Ent.* **51** no. 3 p. 404, 2 refs. Menasha, Wis., 1958.

Selenaspidus articulatus (Morg.) is an important pest of robusta coffee [*Coffea robusta*] in Ecuador, defoliating it and greatly reducing production. It also attacks arabica coffee [*C. arabica*], but the population density appears to be lower on the latter where both species occur together. As *C. robusta* is being widely planted in the coastal area, the Coccid may become important there. In investigations at Pichilingue, counts on plants of *C. robusta* and *C. arabica* sown at the same time in adjacent plots showed averages of 47 and 2·2 scales per leaf, respectively, and 35·2 and 5·3 per 100 sq. cm. leaf surface; a survey of *C. robusta* indicated that infestations tended to be concentrated in adjacent groups of bushes, suggesting that ants, which are common in coffee plantings, may be involved in their distribution. Thorough spraying of young bushes with 2 per cent. oil emulsion, 3 lb. 15 per cent. wettable parathion per 100 U.S. gal. and 1·5 per cent. oil with 1·5 lb. 15 per cent. parathion per 100 U.S. gal. on 4th February 1955 resulted in 57·1, 74·4 and 97 per cent. mortality of *S. articulatus*, respectively, on 8th March. The differences were significant, but population counts on 8th March, 23rd July and 23rd October 1955, and on 3rd July 1956 after additional treatments on 24th February 1956, showed no significant difference between treatments, all of which controlled the scale. These results suggested that oil alone was more effective than was indicated by the mortality counts; it has a long residual action and probably prevented the crawlers from becoming established. Numbers had increased in all plots in October, but experience indicated that control could be obtained with an average of two applications of the mixture of oil and parathion in three years. Sprays containing oil slightly damaged the immature terminal leaves, but the injury was not serious.

Dresner (E.). **A poison Bait for the Control of** *Leptocorixa acuta* **(Thunb.).** —*J. econ. Ent.* **51** no. 3 p. 405, 1 ref. Menasha, Wis., 1958.

No adequate method of controlling *Leptocorisa acuta* (Thnb.), one of the most important pests of rice in Indonesia, has hitherto been known [*cf. R.A.E.*, A **43** 351], but a newly developed poison bait has proved very effective. Crustacea of the genus *Potamon*, which make holes in the walls enclosing the flooded fields and also attack the rice plants, are collected, dipped in a 0·2 per cent. suspension of dieldrin with cassava flour as an adhesive, and tied near the heads of the flowering rice plants, not more than about 23 ft. apart. They become attractive within two days, as putrefaction

sets in, and remain so for up to 21 days, if moist conditions obtain. They are most attractive to the adult males, but the use of more than 80 baits per acre with an adequate contact insecticide can eliminate the entire population from a field in one night. Other Crustacea, *Achatina fulica* (with the shell cracked), pieces of fish, rats and some plants, such as *Hydrilla verticillata*, can also be used. The bait can be enclosed in small bags, dipped in dieldrin, to keep it damp longer and provide a bigger surface area, but this requires more insecticide. The method is laborious, but cheap, and thus suitable to Indonesian conditions.

Davidson (J. A.) & McComb (C. W.). **Notes on the Biology and Control of *Fiorinia externa* Ferris.**—*J. econ. Ent.* **51** no. 3 pp. 405–406, 1 fig., 1 ref. Menasha, Wis., 1958.

Fiorinia externa Ferris infests the foliage of hemlock [*Tsuga*], and to a less extent of yew [*Taxus*] and spruce [*Picea*], in Maryland, and also occurs in New York, Connecticut, Pennsylvania, Ohio and New Jersey. Infestations are commonly heavy, and the wax threads secreted render the trees unsightly. Field observations showed that active crawlers and all later stages of both males and females are present throughout the year, but that reproduction reaches its maximum in spring and autumn. The females do not cast the nymphal skin on becoming adult, but contract and occupy the anterior half of it. The remainder becomes filled with eggs, which are laid progressively as those already present hatch. About six eggs are present at a time. The long period over which the eggs are laid and the protection afforded to the crawlers render control by insecticides difficult. Mixtures of malathion and DDT gave excellent kills of crawlers, but the number of applications necessary was prohibitive, and systemic insecticides failed to kill the adult females. The Coccids are parasitised by Aphelinids of the genus *Prospaltella*, parasitism reaching 16·6 per cent. among the females of one collection.

Rivas (A. M.) & Buchanan (W. D.). **A new Technique for rearing Carpenterworms.**—*J. econ. Ent.* **51** no. 3 pp. 406–407, 2 figs. Menasha, Wis., 1958.

The authors describe a method of rearing wood-boring larvae, developed in connection with research on *Prionoxystus robiniae* (Peck), that permits observation of their progress. An artificial medium, consisting of 230 g. sawdust from the species of tree in which the insect is found, is mixed with a hot solution of 20 g. agar in 1 l. water, packed in an upright cage of glass or clear plastic, 10 × 6 × 0·7 in. or of other suitable dimensions, and allowed to cool. A small wire-mesh basket containing the larva is fastened over an entrance hole, 0·7 in. high and about 1·5 in. from the bottom of one edge, and the top of the cage is sealed. A small hole dug into the medium facilitates entry. By January 1958, larvae of *P. robiniae* had fed in such cages for 41 days without apparent reduction in activity.

Hornstein (I.), Sullivan (W. N.) & Murphy (R.). **Fumigation Properties of Dow ET-57.**—*J. econ. Ent.* **51** no. 3 pp. 408–409, 3 refs. Menasha, Wis., 1958.

In the course of experiments noticed in more detail elsewhere [*R.A.E.*, B **47** 140] on the control of insects in aircraft by means of Dow ET-57 [O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate] released from an impregnated glass-wool air-conditioning filter mounted on an oscillating fan in the

fuselage, the concentration of ET-57 in the air increased from 0·03 μg. per litre at 15°C. [59°F.] to 0·09 μg. at 24°C. [75·2°F.] and 1·5 μg. at 45°C. [113°F.], and mortality of adults of *Tribolium confusum* Duv. in open petri dishes from 53 per cent. at 25–27°C. [77–80·6°F.] to 100 per cent. at 24–33°C. [75·2–91·4°F.]. The beetles were exposed for four hours, and mortality was determined after 96 hours.

Neunzig (H. H.) & Gyrisco (G. G.). **Host Relationships of Seed Chalcids reared from Birdsfoot Trefoil.**—*J. econ. Ent.* **51** no. 3 pp. 409–410, 4 refs. Menasha, Wis., 1958.

Recent work in the Soviet Union has shown that *Bruchophagus gibbus* (Boh.) is restricted to red clover (*Trifolium pratense*) and *T. medium* and that the Eurytomids infesting the seeds of other leguminous plants are distinct species previously confused with it. Of these, *B. roddi* (Gussakovskiĭ) [of which *B. gibbus* subsp. *medicaginis* Kolobova (*R.A.E.*, A **41** 165) is a synonym] is restricted to lucerne (*Medicago sativa*) and *M. falcata*, and *B. kolobovae* Fedoseeva infests *Lotus corniculatus*.

L. corniculatus in New York is infested by insects of this group, presumably *B. kolobovae*, though no comparisons with European material have been made. In tests in which populations of 30 males and females, reared from *L. corniculatus*, were caged on the seed-heads of various leguminous plants, no insects were dissected or reared from lucerne or red clover or from *L. americanus* or *L. tetragonolobus*, whereas oviposition and development occurred on *L. corniculatus*, *L. tenuis*, *L. uliginosus* and *L. hispidus*. Attacks were limited to plants with seeds no larger than those of *L. corniculatus*. It is pointed out in a footnote that insects reared from lucerne and red clover readily oviposited in the developing seeds of these two plants, and their progeny developed. Subsequent investigations in naturalised stands of *L. tenuis* in eastern New York showed that infestation was heavy, and cage tests with the insects concerned confirmed the results obtained with those from *L. corniculatus*.

Oatman (E. R.). **Variegated Cutworm Injury to ripe Strawberries.**—*J. econ. Ent.* **51** no. 3 pp. 410–411, 1 fig. Menasha, Wis., 1958.

Severe injury was caused to ripe strawberries near Sturgeon Bay, Wisconsin, in July 1957 by larvae of *Peridroma saucia* Hb. (*margaritosa* (Haw.)). These were most numerous at the lower end of the field, where there was a fairly heavy growth of oats in the strawberry rows as a result of an oat-straw mulch applied in the previous autumn. Thorough spraying with 1 lb. malathion per acre and laboratory dusting of field-collected larvae and the strawberry fruits and foliage on which they were fed with an excessive dosage of 1 per cent. rotenone dust caused no mortality.

Tao (Chia-hwa). **Control of Paddy Borer on the second Rice Crop in 1957.**—*J. econ. Ent.* **51** no. 3 p. 411. Menasha, Wis., 1958.

Schoenobius incertulas (Wlk.) is an important pest of rice in southern Formosa, where it has 5–6 generations a year, and tests were made in 1957 on its control on the second crop, which is attacked by the fourth and fifth generations. The rice was transplanted on 3rd August and treated on 6th and 30th September and 5th October with 0·571 or 1·142 lb. insecticide per acre, applied in 71·2 gal. emulsion spray per acre on the first date and in

106·8 gal. on the other two. Endrin, Guthion [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] and parathion (Folidol) were rather more effective than Trithion [O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate] or methyl-parathion, and the higher dose was generally better than the lower. Treatments reduced the percentage of dead seedlings from 6·3 to 1·4–4·1 and the percentage of empty panicles from 11·9 to 3·5–9·8 and increased the yield from 3,933 to 4,356–5,436 lb. per acre. All increases in yield were significant.

Pond (D. D.). **Susceptibilities of four Species of Potato-infesting Aphids to Insecticides.**—*J. econ. Ent.* **51** no. 3 pp. 414–415, 7 refs. Menasha, Wis., 1958.

Since the variable control of aphids on potato given by DDT in different parts of New Brunswick may be due to differences in relative numbers of the species present, the effect of some insecticides on *Myzus persicae* (Sulz.), *Macrosiphum solanifolii* (Ashm.), *Aphis abbreviata* Patch and *M.* (*Myzus*) *solani* (Kalt.) was tested under controlled conditions in the greenhouse. Detached potato leaves were sprayed with 2·5 lb. 25 per cent. wettable malathion or 40 per cent. wettable toxaphene, 5 lb. 20 per cent. DDT or 0·625 lb. 20 per cent. lindane [almost pure γ BHC] in emulsion concentrates, all per 100 U.S. gal., or a mixture of the toxaphene and DDT formulations, allowed to dry for two hours and then infested with five aphids each. They were examined every 24 hours and reinfested if no living aphids were found. The average numbers of days before establishment resulted, as shown by reproduction, were noted, and it appeared from the results that malathion was significantly superior to all the other treatments, except to DDT alone or with toxaphene against *M. solani* and to toxaphene alone or with DDT against *Myzus persicae*. The order of toxicity varied for the different species, and it is concluded that a compound lethal to one species of aphid on potato may have no effect on another in a heterogeneous population.

Johnson (N. E.) & Wright (K. H.). **The Balsam Woolly Aphid Problem in Oregon and Washington.**—*Res. Pap. Pacif. Nthwest For. Exp. Sta.* no. 18, [1+] iii + 34 pp., frontis., 4 pls., 1 map, 15 refs. Portland, Ore., 1957.

Chermes (*Adelges*) *piceae* Ratz. was found in the Pacific Northwest of the United States after 1930 infesting *Abies grandis*. It remained of little importance until 1954, when destructive outbreaks began on *A. amabilis* in south-western Washington and *A. lasiocarpa* near Mount Hood in Oregon. Losses have since then been considerable. The life-cycle of the insect in the north-west is not completely known, but it has two overlapping generations a year on *A. amabilis*. Only females are present. Natural enemies afford little control, and the use of insecticides is at present impracticable, owing to the nature of the forest stands. Silvicultural methods seem the most promising, and a committee was set up in 1956 to promote investigation of the problem.

Silver (G. T.). **Studies on the Silver-spotted Tiger Moth, *Halisidota argentata* Pack. (Lepidoptera: Arctiidae), in British Columbia.**—*Canad. Ent.* **90** no. 2 pp. 65–80, 16 figs., 4 refs. Ottawa, 1958.

The following is based mainly on the author's summary. *Halisidota argentata* Pack., all stages of which are described, is a potentially important

defoliator of Douglas fir (*Pseudotsuga menziesii* (*taxifolia*)) in the south-western coastal district of British Columbia, where an outbreak developed in 1953 and increased in intensity until the spring of 1956, after which it collapsed suddenly in the southern part of its range. *P. menziesii*, which is attacked at all ages, is the preferred food-plant, but larvae were also collected from many other conifers. The bionomics of the Arctiid were studied in 1954–55, mostly in the insectary. Adults emerged between late July and the end of August, and the females laid an average of 300 eggs each, usually on the south or west sides of the crowns of scattered trees. The larvae hatched in about a month and fed singly on the needles, congregating in loose silken webs when not feeding. They passed through 7–8 instars and over-wintered in the third, fourth or fifth, feeding in fine weather and usually moulting once during the winter. Regular feeding was resumed in April, and each colony then defoliated 1–4 lateral branches for a distance of 3–5 ft. from the tip. The colonies dispersed in early May, when the larvae spread over the entire crown or left the tree, sometimes first migrating to the top and defoliating the terminal branch. In the insectary, they constructed cocoons during May–August, mostly in June. In the field, cocoons were found on the undersides of branches and on tree trunks, dead stems and shrubs. Pupation occurred about a week later, and the pupal stage averaged 45 days. Although a single colony can cause considerable defoliation, there was no tree mortality. No tree supported enough colonies to cause complete defoliation, and heavy spring feeding was restricted to the previous year's foliage. The buds were unharmed and produced a normal complement of needles. Ten species of parasites were reared from the larvae and pupae, but their attack was light. No diseases were observed. Predators, especially *Formica obscuripes* Forel, caused some mortality, but are not considered of importance as control agents. Of over 5,000 larvae placed on trees in the autumn, less than 1 per cent. survived until June, most colonies disappearing between January and March. It is therefore believed that winter mortality, probably due to adverse weather, is a controlling factor.

Bucher (G. E.) & Stephens (J. M.). **A Disease of Grasshoppers caused by the Bacterium** *Pseudomonas aeruginosa* **(Schroeter) Migula.**—*Canad. J. Microbiol.* **3** no. 4 pp. 611–625, 2 graphs, 26 refs. Ottawa, 1957.

Baird (R. B.). **Field Experiments with** *Pseudomonas aeruginosa* **(Schroeter) Migula to control Grasshoppers.**—*Canad. Ent.* **90** no. 2 pp. 89–91, 2 refs. Ottawa, 1958.

It is stated in the first paper that a bacterium, *Pseudomonas aeruginosa*, was repeatedly isolated from cultures of grasshoppers (*Melanoplus bilituratus* (Wlk.) (*mexicanus*, auct.) [*cf. R.A.E.*, A **47** 128], *M. bivittatus* (Say), *M. packardii* Scudd. and *Camnula pellucida* (Scudd.)) that were suffering high mortality in the laboratory in Canada. It was not found in grasshoppers collected in the field from Ontario westwards to British Columbia. The bacterium and the symptoms caused by it are described, five strains of it are differentiated, and experiments in which grasshoppers were infected with it by injection into the body cavity or by feeding are recorded. The LD50's by the two methods were 10–20 and 8,000–29,000 bacteria per insect.

The following is based mainly on the author's summary of the second paper. Field trials were conducted in Alberta in 1954 to determine whether the artificial distribution of *P. aeruginosa* would contribute to the biological control of a natural population. The bacterium was cultured in a liquid medium containing 0·8 per cent. of a proprietary dehydrated nutrient broth and also sucrose, casein and mucin, which reduce the effects of desiccation,

and this, after dilution, was applied to egg-beds in the field, where the species represented included *M. bivittatus* and *M. bilituratus*. Bait pellets, consisting of a mixture of bran, flour and finely powdered peat with the incubated nutrient broth, were broadcast among a population of adults and nymphs in all stages, in which *M. bivittatus* predominated and *M. bilituratus* and *C. pellucida* were also present. The order of concentration of the bacteria in the bait was 5×10^9 per g., and the amount of bait necessary to provide one grasshopper with the equivalent of the LD50 was 0·002 mg. Some mortality was caused by both methods of application, but it was economically insignificant, though the results for the eggs were inconclusive owing to the low hatch.

Morgan (C. V. G.) & Anderson (N. H.). **Notes on Parathion-resistant Strains of two phytophagous Mites and a predacious Mite in British Columbia.**—*Canad. Ent.* **90** no. 2 pp. 92–97, 14 refs. Ottawa, 1958.

Parathion was recommended for use in orchards in British Columbia in 1949 [*cf. R.A.E.*, A **39** 2], when it gave good control of *Panonychus* (*Metatetranychus*) *ulmi* (Koch), *Tetranychus telarius* (L.) and *Vasates schlechtendali* (Nal.), but by 1953 evidence was obtained of the presence of resistant strains of *P. ulmi* [*cf.* **45** 146] and some difficulty had been experienced in controlling *T. telarius*; resistance was subsequently demonstrated in other mites. Investigations were carried out in the Okanagan Valley during 1951–55 in a commercial apple orchard, in which recommended treatments applied in previous years had practically eliminated predacious mites and in which the phytophagous species present were *P. ulmi*, *V. schlechtendali* and *Eotetranychus carpini borealis* (Ewing), with small numbers of *T. telarius* and the species of *Bryobia* described by the authors as *B. arborea* [**47** 118], and also in two neglected apple orchards that had not been sprayed for 10–15 years, in which *Eriophyes pyri* (Pgst.) caused extensive damage, *B. arborea* and *V. schlechtendali* were also numerous, and the principal predacious species included *Typhlodromus* spp. In each year, plots in each orchard received three applications of a spray containing 1 lb. 15 per cent. wettable parathion per 100 gal. water on about 1st and 20th June and 1st August, as recommended for control of the codling moth [*Cydia pomonella* (L.)], and mite populations were estimated at intervals during the summer. Within two years, resistant strains of *P. ulmi* and *V. schlechtendali* developed in the commercial orchard and of *V. schlechtendali* in the neglected ones. In 1953, more winter eggs of *P. ulmi* were deposited on trees sprayed three times with parathion than on trees on which the third application was omitted or on those sprayed three times with 50 per cent. wettable DDT at 1·5 lb. per 100 gal. water or left unsprayed, and in 1954 and 1955, *P. ulmi* was more numerous on trees sprayed with parathion than on those sprayed with DDT. Numbers of *V. schlechtendali* followed the same general trend. *Typhlodromus* spp. were practically eliminated by the parathion sprays until late in the summer of 1952, when relatively large numbers of *T. occidentalis* Nesbitt occurred a few weeks after the last application. From 1953 to 1955, the numbers of *T. occidentalis* on trees sprayed with parathion in all three orchards were usually as great as or greater than those of *Typhlodromus* spp. on unsprayed trees. It is not known whether *T. occidentalis* is inherently tolerant of parathion or whether a resistant strain evolved as a result of exposure to the acaricide. The parathion schedule markedly reduced the numbers of *E. pyri* and controlled *B. arborea* in the neglected orchards, practically eliminated aphids and Cicadellids in all three and led to an increase in the vigour of the trees.

Coppel (H. C.) & Smith (B. C.). **Studies on Dipterous Parasites of the Spruce Budworm,** *Choristoneura fumiferana* **(Clem.) (Lepidoptera: Tortricidae). V.** *Omotoma fumiferanae* **(Tot.) (Diptera: Tachinidae).** —*Canad. J. Zool.* **35** no. 5 pp. 581–592, 15 figs., 20 refs. Ottawa, 1957.

This fifth paper of a series on the Dipterous parasites of *Choristoneura fumiferana* (Clem.) in British Columbia [*cf. R.A.E.*, A **43** 134; **44** 156] contains descriptions of the immature stages and of the reproductive systems of *Winthemia* (*Omotoma*) *fumiferanae* Toth., the commonest native Tachinid parasite of this Tortricid there, together with an account of field and laboratory studies on its bionomics. The laboratory studies were made in Ontario with material received from British Columbia, which was reared at 23°C. [73·4°F.] and 60 per cent. relative humidity. The adults were fed on crushed raisins and 10 per cent. honey solution, and the parasite was successfully reared in larvae and pupae of *C. fumiferana*, *Pyrausta nubilalis* (Hb.) and *Pieris rapae* (L.) and in larvae of *Galleria mellonella* (L.), which, however, the newly hatched larvae had some difficulty in entering. Newly emerged females mated readily with males that had emerged at least two days earlier; females usually mated only once. Eggs were usually laid on the thorax of the host, up to 15 being laid on each. The average total number of eggs laid per female was 25·2, but many mated females did not oviposit. The preoviposition and oviposition periods lasted 8–11 and 2–19 days, respectively, and the egg stage 3–5 days, the larvae usually hatching and entering the host when it began to pupate. On reaching the third instar they consumed the vital organs of the host, and when full grown, 8–12 days after egg deposition, left it to pupate, for which, in the field, they enter the soil. About 72–75 per cent. of the pupae overwintered, and the rest gave rise to adults in 20–25 days. Females were rather more numerous than males. Ovipositing females survived for 5–39 days and males for up to 25 days. In British Columbia, adults from overwintered puparia are present in late May, throughout June, when the larvae of *C. fumiferana* are becoming full-fed, and, at altitudes of over 4,000 ft., well into July. A few first-generation adults are present in mid-August. Though 12 or more eggs per host were commonly found on field-collected larvae of *C. fumiferana*, not more than two and usually only one parasite completed development. Some host larvae were attacked by both *W. fumiferanae* and the ectoparasite, *Phytodietus fumiferanae* Rohw., in which case the surviving species appeared to be the one most advanced in development. In 1947, *Mormoniella* (*Nasonia*) *vitripennis* (Wlk.) emerged from many of the puparia of *W. fumiferanae*.

In 1947–49, parasitism by *W. fumiferanae* amounted to 8·8–44·14 per cent. of the total parasitism of *C. fumiferana* in British Columbia; the amounts due to it did not differ significantly at altitudes within the range 1,000–4,000 ft., at which infestation by *C. fumiferana* is heaviest, and the percentages of larvae on Engelmann spruce [*Picea engelmanni*], Douglas fir [*Pseudotsuga menziesii*] and alpine fir [*Abies lasiocarpa*] parasitised by it were 4·59, 2·88 and 1·73, respectively.

W. fumiferanae was also reared from larvae of *C. fumiferana* collected in Ontario, Quebec and Newfoundland, and adults were captured in infested areas in New Brunswick, but the Tachinid was not abundant in eastern Canada. Laboratory stocks for release there were reared from larvae collected in western Canada and Colorado, and at the time of writing over 8,000 adults had been liberated, mostly in New Brunswick and Ontario, but also in Quebec and Newfoundland; a small shipment was sent to New York.

Riordan (D. F.). **Effects of a high Temperature on the Fertility of** *Dahlbominus fuscipennis* **(Zett.) (Hymenoptera: Chalcidoidea).**—*Canad. J. Zool.* **35** no. 5 pp. 603–608, 2 graphs, 7 refs. Ottawa, 1957.

The following is based partly on the author's summary of this account of further work on the effect of heat on *Dahlbominus fuscipennis* (Zett.) [*cf. R.A.E.*, A **44** 158; **46** 331]. Females were more resistant than males to both the lethal and sterilising effects of exposure to 43°C. [109·4°F.]. The period required for 50 per cent. mortality was 110 minutes for the former and 74 minutes for the latter, and, after exposure for these periods, 68 per cent. of the surviving females and 84 per cent. of the surviving males were sterile. Three major effects on fertility, namely permanent sterility, reduced fertility, and inactivation of the spermatozoa stored in the spermathecae, were observed in the females, and some indication was obtained of partial sterilisation of those that survived treatment for 114 minutes or longer. The percentage reduction in female progeny (which develop from fertilised eggs) amounted to 58, 83 and 97 after exposure for 66, 87 and 114 minutes, respectively. Sterility induced in the males by heat treatment was usually permanent, and the percentage of sterile males increased from 50 after exposure for 50 minutes to 91·7 after exposure for 71 minutes.

Robertson (J. G.). **Changes in Resistance to DDT in *Macrocentrus ancylivorus* Rohw. (Hymenoptera: Braconidae).**—*Canad. J. Zool.* **35** no. 5 pp. 629–633, 1 graph, 21 refs. Ottawa, 1957.

The following is substantially the author's summary of this account of further work in Canada on the development of a laboratory stock of *Macrocentrus ancylivorus* Rohw. resistant to DDT [*cf. R.A.E.*, A **40** 183; **41** 376]. Exposure to concentrations of 23 μg. DDT per sq. cm. for three minutes in each of ten successive generations increased the level of resistance to four times that of the original stock. The concentration of DDT was then increased to 96 μg. per sq. cm., and resistance reached a maximum of 12 times that of the initial stock at the F_{19} generation, but declined to nine times the original level at the F_{29} generation. During the F_{30}–F_{71} generations, only females were exposed to DDT and the level of resistance fell to seven times its initial value. When, beginning with the F_{72} generation, the parasite was reared for 13 generations without exposure to DDT, resistance fell to its initial level. Females were more resistant to DDT than males.

Parent (B.). **Observations biologiques sur le pique-bouton du pommier, *Spilonota ocellana* (D. & S.) dans le Québec.**—*Ann. ent. Soc. Quebec* **2** (1956) pp. 42–51, 3 graphs, 12 refs. Quebec, 1957. (With a Summary in English.)

Some aspects of the bionomics of *Spilonota ocellana* (Schiff.) in Quebec were investigated in orchards in the four main apple-growing districts in 1949–56. Infestation varied in intensity according to district, but was heavier in general during 1949–51 than during 1952–56. Overwintered larvae usually appeared at the end of April or the beginning of May (about the green-tip stage of apple). They pupated mostly in June, and adults were present from about mid-June until mid-August, with a peak in July. Oviposition began in late June or early July, and hatching continued from about 10th July until the end of that month or the beginning of August; in 1955, the egg stage lasted for an average of 8 days. The larvae remained on the leaves and fruits until the beginning of October, when they constructed shelters in which to overwinter. The most important natural enemies were a Braconid parasite, *Agathis laticincta* (Cress.), which parasitised 15–50 per cent. of the larvae, and *Haplothrips faurei* Hood, which fed mainly on the eggs. Other parasites included *Trichogramma minutum* Ril., *Itoplectis*

conquisitor (Say) and *Ephialtes* (*Scambus*) *tecumseh* (Vier.), which was observed only in 1953 and had not previously been recorded from this host.

Duncan (J.), Généreux (H.) & Couture (G. R.). **La dissémination dans le champ de la mosaïque et de l'enroulement des feuilles par les pucerons de la pomme de terre.**—*Ann. ent. Soc. Quebec* **2** (1956) pp. 53–59, 2 refs. Quebec, 1957. (With a Summary in English.)

The distance over which the leaf-roll and mosaic virus diseases of potato can be spread from individual infected plants by their aphid vectors was investigated in Quebec in 1950–55. Four plots, each consisting of two rows of 30 plants, of which one of the two central ones was infected with mosaic and the other with leaf-roll and the rest were healthy, were used each year. The plants were 18 in., and the rows 3 ft., apart. The species and numbers of aphids present were determined every ten days from 15th July; the species represented were *Macrosiphum solanifolii* (Ashm.), *Myzus persicae* (Sulz.) and *Aphis abbreviata* Patch. The plots were harvested on 15th August, 1st and 15th September, and 1st October, respectively. The position of each plant was recorded, its tubers were kept separate, and in the following year the percentage of healthy plants derived from it was determined. The results indicated that infection with both diseases spread up to the limits of the rows during the season in some cases, but that susceptibility increased with proximity to the source [*cf. R.A.E.*, A **37** 91]. The spread began about 15th August and increased progressively until the end of the season. The prevailing winds appeared to be of importance, but no correlation was found between the populations of different aphid species and virus spread.

Paradis (R. O.). **Observations sur le cycle évolutif du charançon de la prune,** *Conotrachelus nenuphar* **(Hbst.) sur la pomme dans le Québec.** —*Ann. ent. Soc. Quebec* **2** (1956) pp. 60–70, 5 refs. Quebec, 1957.

Studies were carried out on the bionomics of *Conotrachelus nenuphar* (Hbst.) on apple under orchard conditions in Quebec in 1950–55, and the following is based almost entirely on the author's summary of the results. Overwintered adults appeared during May, about 11 days before the apple trees were in full bloom; emergence reached a peak between about six days before full bloom and ten days after petal-fall, when mean daily air temperatures reached 61°F. and the temperature of the soil at a depth of 1 in. was 58°F. Oviposition began at the end of May, with the setting of the first fruits, and continued until the beginning of August. The females deposited a mean total of 73 eggs each. The larvae hatched in a mean of 3–12 days at 64–77°F., fed within the fruits for an average of 18 days, and entered the soil for pupation between the end of June and August. The period spent in the soil averaged 27·6–32·5 days. Emergence of the first-generation adults began at the end of July, reached a peak between 10th August and 5th September, and ended during the last half of September Total development lasted an average of 54 days. The adults survived for 5–24 months, and most died during their first or second winter. The commonest parasite reared was *Triaspis kurtogaster* Martin, which caused some mortality among larvae and pupae in the soil and has not hitherto been recorded from Quebec.

Robert (A.). **Note sur la teigne du lilas** *Gracilaria syringella* **(Fab.) (Lépidoptères: Gracilariidae).**—*Ann. ent. Soc. Quebec* **2** (1956) pp. 71–74, 5 refs. Quebec, 1957.

Heavy infestation by *Gracillaria syringella* (F.) [*cf. R.A.E.*, A **13** 577], an introduced species that is apparently distributed wherever lilac is grown

in Canada, was reported in 1954 at a place in Quebec, where the leaves on a long lilac hedge had all been damaged and had turned brown by the end of August and most had already fallen. Eggs of the second generation normally hatch at the beginning of August, but in 1956 newly hatched larvae were found about 20th September. At the beginning of October, some began to feed outside their mines, but the leaves fell before they were fully grown, and they continued to feed on leaves on the ground. They were unaffected by the first frosts or by heavier ones on 6th–7th November, but on 17th November there was considerable mortality among larvae exposed to frost while in contact with wet leaves; those among dry leaves survived. Larvae brought indoors towards the end of September became fully grown during the last half of October, but had not given rise to adults after a further two months, and it is concluded that diapause is essential for the completion of development.

Boczkowska (M.). **Quelques observations sur les dégâts causés par** *Psila rosae* **F. sur diverses variétés de carottes cultivées à la ferme expérimentale de Sainte-Anne-de-la-Pocatière au cours de l'année 1956.**—*Ann. ent. Soc. Quebec* **2** (1956) p. 75, 2 refs. Quebec, 1957.

Observations on *Psila rosae* (F.) on carrot in Quebec in 1956 showed that attack by the larvae continued from about 11th July until mid-August, when pupation took place. The adults appeared at the end of August. Infestation varied from 28 to 74 per cent. on 12 of 14 varieties, but was 6·85 and 9·35 per cent. on the two others.

Hudon (M.) & Perron (J. P.). **Méthode pour l'obtention et la manipulation de grandes quantités de masses d'oeufs de la pyrale du maïs,** *Pyrausta nubilalis* **(Hbn.) (Lépidoptères: Pyralidae).**—*Ann. ent. Soc. Quebec* **2** (1956) pp. 76–80, 2 figs., 6 refs. Quebec, 1957. (With a Summary in English.)

A method is described for the mass production of eggs of *Pyrausta nubilalis* (Hb.), modified from previous ones [*cf. R.A.E.*, A **21** 242; **37** 244] and designed to provide material for artificial infestation. Adults, obtained from infested maize stalks cut in autumn and kept during the winter in large cages in the open, are placed in screen oviposition cages each having a sheet of waxed paper held in place by a piece of plywood on top of it. The cages are kept under constant conditions of 80°F. and 96 per cent. relative humidity [*cf.* **38** 240]. The females oviposit through the mesh on to the waxed paper, which is changed daily. Small disks, each bearing 1–2 egg-masses, are cut from the paper, mounted on pins and kept in small vials at 40°F. for a few days. They are placed in the sheaths of maize plants about a week before hatching is due. More than 14,000 egg-masses were obtained by this method in July 1956.

Herne (D. C.) & Chisholm (D.). **Accumulation of DDT in the Soil of an Ontario Peach Orchard.**—*Canad. J. Soil Sci.* **38** no. 1 pp. 23–26, 5 refs. Ottawa, 1958.

The following is largely the authors' summary. The accumulation and distribution of DDT in the soil was studied in a peach orchard in Ontario, in which known amounts of DDT had been applied to the foliage in dilute sprays with considerable run-off in 1946–48 and relatively little in 1949–51

and in concentrated sprays by means of a mist blower providing practically no run-off in 1952–54. At the time of sampling, 41·4 lb. DDT had been applied to one of the two plots investigated, each about an acre in size, and 64·6 lb. to the other. Run-off from the foliage was found to be an important factor in the rate of DDT accumulation. Approximately 95 per cent. of the accumulated insecticide was retained in the cultivated layer, and the amounts near the trunks of the trees were significantly greater than those under the peripheries of the trees or midway between neighbouring trees [*cf. R.A.E.*, A **43** 211].

Outbreaks and new Records.—*FAO Plant Prot. Bull.* **7** no. 7 pp. 101–102. Rome, 1959.

G. H. Berg reports that a campaign was begun in January 1959 to prevent the spread of *Ceratitis capitata* (Wied.) from Costa Rica [*cf. R.A.E.*, A **46** 121, etc.] into neighbouring countries. Buffer zones were established on both sides of the frontiers with Nicaragua and Panama, and trapping was carried out in them to detect the possible presence of the fruit-fly. Liquid bait consisting of protein hydrolysate and ammonium chloride mixed with water was exposed on trees in the Nicaraguan sector in February 1959 at El Castillo and Isla Grande, on the San Juan River, between Lake Nicaragua and the Caribbean Sea, and one male was taken on sour orange at the first place and a female on star apple (*Chrysophyllum cainito*) at the second in early April. Eradication measures, consisting of sprays of protein hydrolysate and malathion applied to the trees and treatment of the soil under possible food-plants with heptachlor, were put into effect, and no further infestation was found, either at the treated sites or elsewhere in the area. The flies found probably originated from fruit brought in from Costa Rica by water.

Müller (F. P.). **Die Hauptwirte von** *Myzus persicae* **(Sulz.) und von** *Aphis fabae* **Scop.** [The primary Food-plants of *M. persicae* and *A. fabae*.]—*NachrBl. dtsch. PflSchDienst* (N.F.) **11** pt. 2 pp. 21–27, 25 refs. Berlin, 1957. (With Summaries in English & Russian.)

The results are given of investigations on the primary food-plants of *Myzus persicae* (Sulz.) and *Aphis fabae* Scop. in the Rostock area of north-eastern Germany. Although *M. persicae* has long been known to overwinter in the egg on peach, such overwintering is also completed on other plants [*cf. R.A.E.*, A **46** 194, etc.]. Small numbers of gynoparae and oviparae were present in the autumn of 1955 on the lower surfaces of the leaves of *Prunus serotina* growing at the edge of a wood to the west of Rostock, causing yellow spots on the leaves. The leaves were rolled in spring, and showed a yellow discoloration where the fundatrigeniae were numerous, but infestation was in general light. Alates were present in the first generation of fundatrigeniae, and the aphids were successfully transferred to cabbage, though reproduction on this was at first slow. *P. serotina* is common in the area. Primary infestation of *P. nana* was observed in a botanical garden at Rostock in the spring of 1957, and the fundatrigeniae of the first generation were all apterous. This plant is not common, and its importance as a winter food-plant of the aphid is probably very slight. Overwintering on apricot has been recorded in Switzerland [**35** 381], but was not observed on this plant or on *P. serrulata* by the author. Spring infestation of *Lycium halimifolium* was observed in various parts of eastern Germany in 1954, when the fundatrices

and their offspring produced gall-like malformations, the cause of which had previously been unknown. Anholocyclic overwintering on this plant also occurs, but no galls are then caused. No primary infestation of *L. halimifolium* was observed by the author in 1955 or 1956. In tests in 1956, peach twigs bearing winter eggs were collected in January near Naumburg and kept in a cage in the open near Rostock. The aphids hatched on 3rd April, when the twigs had dried out completely, and 30 were transferred to a fresh peach twig and 60 to a small plant of *L. halimifolium* in a greenhouse. On 16th April, the peach twig still harboured 24 fundatrices, comprising five last-stage nymphs and 19 adults, and the *Lycium* twig 28 fundatrices, of which only one was an adult. By 21st April, both peach and *Lycium* were heavily infested by fundatrigeniae, most of those on *Lycium* occurring on three main shoots. The peach leaves were rolled and showed slight yellowing, but no symptoms were caused on the *Lycium* plant, which was placed in the open and observed until 14th May. It is concluded that the form that overwinters holocyclically on *Lycium* and causes galls is biologically distinct from the one that overwinters on peach and causes no injury when transferred to *Lycium*; it was named subsp. *dyslycialis*, n., by the author in 1955. Holocyclic overwintering on *L. halimifolium* without the occurrence of galls has not been observed in the field. Other observed biological forms of *M. persicae* are reviewed.

Aphis fabae, an important pest of broad beans (*Vicia faba*), has been found to overwinter on *Viburnum opulus* and to a less extent *Philadelphus coronarius*, as well as on its main primary food-plant, *Euonymus europaeus* [*cf.* **39** 127–129]. Alates taken on *Euonymus* at Naumburg on 1st June 1955 were transferred to broad bean, and the nymphs produced were reared on broad bean, *Chenopodium album* or beet. Gynoparae and males appeared from 24th September to 28th October, and totals of 24, 36, 30 and 87 gynoparae were distributed between 24th September and 3rd October uniformly over three twigs, one from each of the winter food-plants. Counts on 8th October showed that the numbers then present were 40, with numerous nymphs, on *Euonymus*, but only 11 on *V. opulus* and 2 on *Philadelphus*, with only small numbers of nymphs on either. Many nymphs were found wandering in the cage, and some on *Euonymus* had evidently migrated from the other two twigs. The twigs were then replaced by a fresh plant of *Philadelphus*, and all the nymphs transferred to it. Of the total of 216, all oviparae, only 20 remained on the plant by 10th October and none on 17th October. Other gynoparae that appeared on broad bean in September–October were transferred with males to a *Euonymus* bush that was left in the open. Oviparae developed, numerous winter eggs were laid, and fundatrices hatched from 25th April 1956, by which time the plant had died. Some were immediately transferred to a fresh *Euonymus* plant, others to the *Philadelphus* plant used the previous autumn and the rest to twigs of *Viburnum* taken from a bush that had become infested with aphids that were successfully transferred to beet and broad bean in the spring of 1956. All the fundatrices on *Philadelphus* and *Viburnum* crawled away or starved on the leaves within a few days without moulting, except one on *Viburnum* that moulted on 5th May before crawling away. Those on *Euonymus* developed normally.

Infestation of *P. coronarius* by black aphids of the group of *A. fabae* is common in spring and early summer in eastern Germany, but not all of them overwinter in the egg on this plant. Tests in Naumburg in 1949–54 showed that aphids causing primary infestation of *Philadelphus* in spring consistently failed to establish themselves on broad bean, and no infestation was observed in the spring and summer of 1947 on broad beans growing near heavily infested *Philadelphus* in the Berlin district. This is believed to indicate the presence of two groups of black aphids on *Philadelphus*, those

of the first overwintering on it in the egg but not damaging broad beans, and those of the other migrating to it in late spring; the latter group includes the aphids that damage broad beans. The form overwintering on *Philadelphus* possibly corresponds to that named *A. philadelphi* by Börner [*cf.* **39** 129], but he later considered this a synonym of *A. fabae*. There was only secondary infestation of *Philadelphus* at Rostock in 1955 and 1956. Since infestation of both *Philadelphus* and broad bean was heavy in the second year and that of *Euonymus* light, *Philadelphus* was suspected of being important in maintaining the population of the bean-infesting form. In a test, however, 40 immature apterae taken from twigs in each of four localities on 26th–30th July and placed on broad bean or beet had mostly left the plants after three days and only a very few aphids from one of the places persisted on bean and a very few from another on beet on 22nd August.

Zech (E.). **Die Flugzeiten des Blattwicklers (*Capua reticulana* Hb.) im Jahre 1955 und der Flugverlauf während der Abende und Nächte.** [The Flight Periods of *Adoxophyes orana* and the Course of Adult Flight during the Evenings and Nights.]—*NachrBl. dtsch. PflSchDienst* (N.F.) **11** pt. 2 pp. 27–32, 9 graphs, 22 refs. Berlin, 1957. (With Summaries in English & Russian.)

Adoxophyes orana (Fisch v. Roesl.) (*Capua reticulana* (Hb.)) caused much damage to fruit trees at Naumburg, to the south-west of Leipzig, in 1953–56, injuring up to 20 per cent. of apple and pear fruits. Investigations were carried out in 1955 on the course of adult flight by means of a trap equipped with an ultra-violet lamp that was operated about 40 ft. above the ground near a planting of apples and pears. There are two generations per year in this area, and adults of the overwintered one were taken from 15th June to 3rd July, and those of the first generation, which were more numerous, from 9th August to 12th September; nearly 80 per cent. of those taken were males. Flight began 1–3 hours after sunset and sometimes continued until daybreak, but 82·9 per cent. of all adults were captured between 10 p.m. and 3 a.m. and 58·3 per cent. after midnight. Females were in the majority until 10 p.m., and males thereafter. Falling night temperatures had little effect on activity, but no flight occurred at temperatures below about 13°C. [55·4°F.] and the optimum was above 18°C. [64·4°F.]. Heavy rain hindered or prevented flight, whatever the temperature.

Simultaneous observations on *Cydia* (*Carpocapsa*) *pomonella* (L.) showed that the adults of the overwintered generation appeared about 10 days earlier than those of *A. orana*, but that the first generations were present together, so that the two moths can be controlled simultaneously.

Schwarz (R.). **Untersuchungen über ein blattlausübertragbares, von Tabakfangpflanzen isoliertes Virus.** [Investigations on an Aphid-transmissible Virus isolated from Trap Plants of Tobacco.]—*Phytopath. Z.* **33** pt. 4 pp. 375–384, 5 figs., 13 refs. Berlin, 1958. (With a Summary in English.)

Trap plants of tobacco set out in the field near Berlin in 1956 became infected in three cases with a virus disease of unknown origin. In investigations, the virus was transmitted mechanically to numerous other plants, and the symptoms caused in them and in tobacco and the physical properties of the virus are described. It was also transmitted in the non-persistent manner by *Myzus* (*Myzodes*) *persicae* (Sulz.) from infected to healthy *Chenopodium*

quinoa. From the symptoms on the various plants, it is thought to belong in the group of lucerne-mosaic virus.

Schvester (D.). **Contribution à l'étude écologique des Coléoptères Scolytides. Essai d'analyse des facteurs de fluctuation des populations chez *Ruguloscolytus rugulosus* Muller 1818.**—*Ann. Epiphyt.* **8** (num. hors série) 162 pp., 35 figs., 5 pp. refs. Paris, 1957.

A detailed study of the bionomics and natural control of *Scolytus* (*Ruguloscolytus*) *rugulosus* (Ratz.) was carried out near Lyons in 1950–54, with special reference to the factors that lead to the sudden outbreaks of this Scolytid that occur on fruit trees, especially cherry, plum and apricot. The nature of the damage caused is described, and the Scolytid is considered a secondary pest, since unthrifty trees are generally attacked more frequently than sound ones. There were two generations a year, the adults emerging in late April or early May and in early August, respectively, and winter was passed by the larvae. At 25°C. [77°F.], the preoviposition period, which is the only phase of the life-cycle not spent beneath the bark of the tree, lasted 2–5 days, and the females laid 26–92 eggs each (with an average of about 55) over a period of 20–30 days, at a rate of 2–3 eggs per day. The eggs hatched and the larvae became full-fed in about 8–10 and 30 days, respectively. The pupal stage lasted 10 days, and was preceded by a prepupal stage of 2–3 days and followed by a period of 1–3 days during which an opening was cut through the bark by the newly emerged adult. Emergence of adults of the overwintered generation occurred 3–5 weeks later from a totally shaded site than from sites receiving sunshine. In the laboratory, the duration of all stages was inversely correlated with temperature, and the period for complete development ranged from 38–40 days at 30°C. [86°F.] to 50–52 days at 25°C. and 82–84 days at 20°C. [68°F.]. Males and females were about equally numerous. The subcortical habitat of *S. rugulosus* in cherry trees had a temperature range about 0–12°C. [0–21·6°F.] higher than that of the surrounding air, depending upon the degree of insolation, and the relative humidity fluctuated between 75 and 100 per cent.

In laboratory investigations on the effects of high temperature on survival, adults were unaffected by exposure to temperatures up to 43°C. [109·4°F.] for 30 minutes, but 2 and 95 per cent. died in an hour at 43°C. and 45°C. [113°F.] and 100 per cent. in three minutes at 50°C. [122°F.], all at 100 per cent. relative humidity. The results were not significantly different when the relative humidity was reduced to 75 per cent. At 75 per cent. relative humidity, larvae died immediately after exposure to 52°C. [125·6°F.] for 10 minutes and within 48 hours of exposure to 50°C. for 30 minutes, but only 2 per cent. died after exposure for 60 minutes to 48°C. [118·4°F.]. The larvae were less resistant at 100 per cent. relative humidity, 96 per cent. mortality occurring within 24 hours of exposure to 48°C. for 60 minutes and all dying after exposure to 50°C. for 30 minutes. When eggs were exposed for 30 minutes at 100 per cent. relative humidity, mortality rose sharply from about 10 per cent. at 35°C. [95°F.] to 100 per cent. at 45°C. In similar studies at low temperature, all the adults died within 21, 35, 28 and 35 days when kept at −4°C. [24·8°F.], 0°C. [32°F.], 5°C. [41°F.] and 8°C. [46·4°F.], respectively, and 100 per cent. relative humidity. The survival of eggs was influenced more by the duration of exposure than by the temperature, the mortality percentages being 26, 53 and 91 at 0°C., and 18, 78 and 100 at 5°C. for exposures of 10, 20 and 30 days, respectively. Studies with young and full-fed larvae were less conclusive, although prolonged for 150 days. Mortality of either greater than 50 per cent. was obtained at 4°C.

[39·2°F.] and 8°C. and 100 per cent. relative humidity, but not at those temperatures and 75 per cent. relative humidity or at 0°C. Although the direct effects of relative humidity were not ascertained, the results of experiments and field observations suggested that high humidity was unfavourable.

Field studies on natural summer mortality, carried out on cherry and apricot, showed that populations of the first generation decreased markedly in 1951 and 1954, which were years of high summer rainfall and relative humidity, with brood survivals of only about five larvae, as compared with 18–20 in the drier, warmer summer of 1952. Mortality due to Hymenopterous parasites fluctuated independently of climate. Summer losses in the second generation varied less from year to year, but tended to follow the same pattern. Winter mortality was investigated in 1950–51 on plum and apricot and in 1951–54 on cherry. For each investigation, one lot of infested wood was maintained at 25°C. and others exposed to normal winter conditions; counts of the insects surviving were made in March. The results showed that winter mortality averaged about 50 per cent., but was sometimes much greater; 2–6·3 per cent. mortality on plum and apricot and 4·8–68 per cent. on cherry was caused by parasites. The parasite populations appeared to be reduced in proportion to those of the host. Only larvae of *S. rugulosus* survived the winter. Eggs laid in autumn hatched before the temperature dropped to a lethal level, or were killed when it did, and no adults were found alive in spring, though dead females were often found at the entrance to galleries [*cf. R.A.E.*, A **20** 204]. At the end of the winter, about 98 per cent. of the larvae were in the final instar and had prepared their pupal cells, which afforded protection against the saturated atmosphere beneath the bark. Mortality among such larvae in late February and early March was only 4·1–6·4 per cent., as compared with 95–98 per cent. for larvae in earlier stages of development.

Fungi (probably *Beauveria tenella* (*densa*)) were the most effective of the natural enemies, under certain conditions. Entire populations of larvae were killed by them in rainy years, but no infested larvae were seen in 1952, and the dependence of infestation on high humidity was confirmed in the laboratory. Birds fed sporadically on the larvae, and a few larvae were killed by predacious Coleoptera. Many mites were found in the galleries and on the adults of *S. rugulosus*; the most important were *Pediculoides ventricosus* (Newp.) and *P. scolyti* Oudm. [*cf.* **20** 204], but although they sometimes destroyed whole populations of larvae, especially in the laboratory, their value in the field was extremely limited. Notes are given on the bionomics of *P. scolyti* and on the characters distinguishing it from *P. ventricosus*. Nematodes of the genus *Parasitylenchus* were also common in the galleries. One, described as *P. dispar* form *rugulosi* n., was of considerable importance, since adults attacked by it were rendered sterile and it was recovered from up to 75 per cent. of the larvae in some populations. The presence of infested adults was readily detected by their habit of boring radially into the wood, instead of vertically beneath the bark. High nematode populations were associated with years of heavy rainfall. The Hymenopterous parasites observed [*cf.* **9** 402] comprised a Braconid, *Ecphylus eccoptogastri* (Ratz.), and six Chalcidoids, *Cheiropachus colon* (L.), *Elachertus* (*Entedon*) *leucogramma* Ratz., *Raphitelus maculatus* Wlk., *Eurytoma morio* Dalm. (*ischioxanthos* Ratz.), *Rhopalicus tutela* (Wlk.) and *Eupelmus* sp., of which all attacked the larvae and all but the last two were fairly common. *Ecphylus eccoptogastri* [*cf.* **20** 716] has two generations a year synchronised with those of the host, but the Chalcidoids have three and sometimes four generations a year, not all of which are always in phase with *S. rugulosus*. The total mortality of *S. rugulosus* due to extrinsic factors in 1951–54 amounted to 65–94·6 per cent.; nematodes caused 0–8·3 per cent.. Hymenopterous parasites 3·8–18 per cent. and climatic conditions 71·8–84·6 per cent.

Infestation Control. A Service to Agriculture and Food Storage.—iv + 32 pp., 12 pls., 1 map, 6 pp. refs. London, Minist. Agric., H.M.S.O., 1958. Price 4*s*

The circumstances in which the Infestation Control Division of the Ministry of Agriculture came into being (in 1947) and the scope and organisation of its activities are outlined, followed by brief accounts of the results of the investigations carried out in Britain by its officers on the control of insect and other pests of stored products, rodents and vertebrate pests of agriculture. A reference list of scientific papers in which more detailed information can be found is appended.

Hopewell (W. W.). **Evaporation Rates of small Drops of two DDT Oil Solutions.**—*Canad. J. Pl. Sci.* **39** no. 2 pp. 204–209, 1 pl., 3 graphs, 8 refs. Ottawa, 1959.

The following is the author's summary. Small drops of an oil solution of DDT in which the solvent is methylated naphthalene and fuel oil (2:7) and the DDT content 10 per cent. decrease in volume rapidly. Drops of 75 microns in diameter and smaller would probably be reduced to one-half their original volume or less by the time they had fallen 100 feet. Drops formed from a solution containing a similar amount of DDT but having base oil and diesel fuel as solvents were much less volatile.

Balduf (W. V.). **Obligatory and Facultative Insects in Rose Hips. Their Recognition and Bionomics.**—*Illinois biol. Monogr.* no. 26, vi + 194 pp., 12 pls., 11 pp. refs. Urbana, Ill., 1959.

The author began his observations on the insects associated with rose hips over 15 years ago, in Illinois, and later extended them to cover many parts of the United States and also some Provinces of Canada. Samples of hips from 32 species or varieties of rose were studied, and over 40 species of insects were found. Of these, 15 were incidental and are not further considered. The others consisted of phytophagous species, facultative or obligate, and their parasites, and information is given on their synonymy, morphology, distribution, food-plants or hosts, and bionomics, based on field and laboratory investigations.

Papers noticed by Title only.

Grison (P.). **L'influence de la plante-hôte sur la fécondité de l'insecte phytophage** [*Leptinotarsa decemlineata* (Say) on potato].—*Ent. exp. appl.* **1** no. 2 pp. 73–92, 6 figs., 71 refs. Amsterdam, 1958. (With a Summary in English.) [For more detailed account see *R.A.E.*, A **47** 295.]

Hall (I. M.) & Dunn (P. H.). **Artificial Dissemination of entomophthorous Fungi pathogenic to the Spotted Alfalfa Aphid** [*Therioaphis maculata* (Buckt.)] **in California.**—*J. econ. Ent.* **51** no. 3 pp. 341–344, 3 refs. Menasha, Wis., 1958. [*Cf. R.A.E.*, A **46** 124, 491.]

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